

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
1 September 2005 (01.09.2005)

PCT

(10) International Publication Number
WO 2005/080335 A1

(51) International Patent Classification⁷: **C07D 209/34**

(21) International Application Number:
PCT/US2005/004373

(22) International Filing Date: 11 February 2005 (11.02.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/544,384 13 February 2004 (13.02.2004) US

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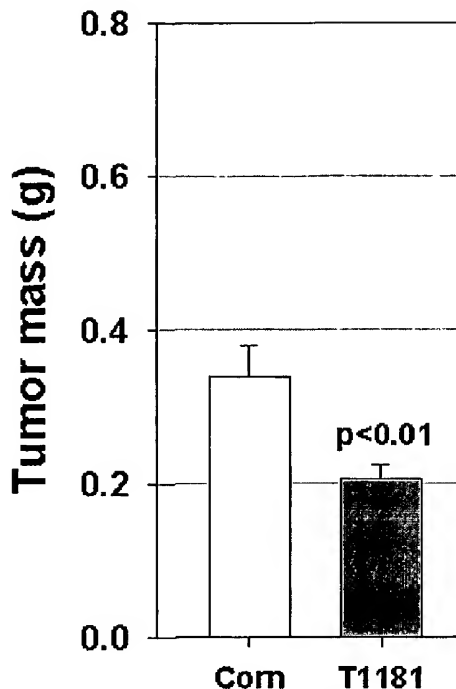
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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,
ZW.

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(54) Title: 3-3-DI-SUBSTITUTED-OXINDOLES AS INHIBITORS OF TRANSLATION INITIATION



(57) Abstract: Compositions and methods for inhibiting translation using 3-(5-tert-Butyl-2-Hydroxy-phenyl)-3-phenyl-1,3-dihydro-indol-2-one and/or its derivatives are provided. Compositions, methods and kits for treating (1) cellular proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infections, using 3-(5-tert-butyl-2-hydroxy-phenyl)-3-phenyl-1,3-dihydro-indol-2-one and/or its derivatives are described.

WO 2005/080335 A1



(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- with amended claims

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

3-3-DI-SUBSTITUTED-OXINDOLES AS INHIBITORS OF TRANSLATION INITIATION

STATEMENT OF GOVERNMENT INTERESTS

- [01] This invention was made with Government support under Grant Number 5 U19 CA87427 awarded by the National Institutes of Health. The Government has certain rights in the invention.

FIELD OF THE INVENTION

- [02] The present invention relates to novel compounds which inhibit translation initiation, pharmaceutical compositions of the novel compounds, and methods of treating medical disorders.

BACKGROUND OF THE INVENTION

- [03] Translation, the mRNA-directed synthesis of proteins, occurs in three distinct steps: initiation, elongation and termination. Translation initiation is a complex process in which the two ribosomal subunits and methionyl tRNA (met-tRNA) assemble on a properly aligned mRNA to commence chain elongation at the AUG initiation codon. The established scanning mechanism for initiation involves the formation of a ternary complex among eukaryotic initiation factor 2 (eIF2), GTP and met-tRNA. The ternary complex recruits the 40S ribosomal subunit to form the 43S pre-initiation complex. This complex recruits mRNA in cooperation with other initiation factors such as eukaryotic initiation factor 4E (eIF4E), which recognizes the 7-methyl-guanidine cap (m⁻⁷GTP cap) in an mRNA molecule and forms the 48S pre-initiation complex. Cap recognition facilitates the 43S complex entry at the 5' end of a capped mRNA. Subsequently, this complex migrates linearly until it reaches the first AUG codon, where a 60S ribosomal subunit joins the complex, and the first peptide bond is formed (Pain (1996) *Eur. J. Biochem.*, 236:747-771).
- [04] Several features of the mRNA structure influence the efficiency of its translation. These include the m⁻⁷GTP cap, the primary sequence surrounding the AUG codon

and the length and secondary structure of the 5' untranslated region (5' UTR). Indeed, a moderately long, unstructured 5' UTR with a low G and C base content seems to be optimal to ensure high translational efficiency. Surprisingly, sequence analysis of a large number of vertebrate cDNAs has shown that although most transcripts have features that ensure translational fidelity, many do not appear to be designed for efficient translation (Kozak (1991) *J. Cell. Biol.*, 115:887-903). Many vertebrate mRNAs contain 5' UTRs that are hundreds of nucleotides long with a remarkably high GC content, indicating that they are highly structured because G and C bases tend to form highly stable bonds. Because highly structured and stable 5' UTRs are the major barrier to translation, mRNAs with stable secondary structure in their 5' UTR are translated inefficiently and their translation is highly dependent on the activity of translation initiation factors.

- [05] mRNAs with complex, highly structured 5' UTRs include a disproportionately high number of proto-oncogenes such as the G1 cyclins, transcription and growth factors, cytokines and other critical regulatory proteins. In contrast, mRNAs that encode globins, albumins, histones and other housekeeping proteins rarely have highly structured, GC-rich 5' UTRs (Kozak (1994) *Biochimie*, 76; 815-21; Kozak (1999) *Gene*, 234:187-208). The fact that genes encoding for regulatory but not for housekeeping proteins frequently produce transcripts with highly structured 5' UTRs indicates that extensive control of the expression of regulatory genes occurs at the level of translation. In other words, low efficiency of translation is a control mechanism which modulates the yield of proteins such as cyclins, mos, c-myc, VEGF, TNF, among others, that could be harmful if overproduced.

SUMMARY

- [06] Translation initiation is a critical step in the regulation of cell growth because the expression of most oncogenes and cell growth regulatory proteins is translationally regulated. One approach to inhibiting translation initiation has recently been identified using small molecule known as translation initiation inhibitors. Without intending to be bound by theory, Figure 1 sets forth a summary of the anti-cancer mechanism of action of translation initiation inhibitors such as clotrimazole (CLT) and the diaryloxindole (DAO) compounds of the present invention. CLT inhibits

translation initiation by sustained depletion of intracellular Ca^{2+} stores. Depletion of intracellular Ca^{2+} stores activates “interferon-inducible” “double-stranded RNA activated” protein kinase (PKR) which phosphorylates and thereby inhibits the α subunit of eIF2. Since the activity of eIF2 is required for translation initiation, its inhibition by compounds such as CLT reduces the overall rate of protein synthesis. Because most cell regulatory proteins are encoded for by mRNAs containing highly structured 5' UTRs, they are poorly translated and their translation depends heavily on translation initiation factors such as eIF2 and eIF4. Therefore, inhibition of translation initiation preferentially affects the synthesis and expression of growth regulatory proteins such as G1 cyclins. Sequential synthesis and expression of G1 cyclins (D1, E and A) is necessary to drive the cell cycle beyond the restriction point in late G1. Thus, the decreased synthesis and expression of G1 cyclins resulting from CLT-induced inhibition of translation initiation causes cell cycle arrest in G1 and inhibits cancer cell and tumor growth (Aktas et al. (1998) *Proc. Natl. Acad. Sci. USA*, 95:8280-8285, incorporated herein by reference in its entirety for all purposes).

- [07] Like CLT, the n-3 polyunsaturated fatty acid eicosapentaenoic acid (EPA) depletes internal calcium stores, and exhibits anti-carcinogenic activity. Unlike CLT, however, EPA is a ligand of peroxisome proliferator-activated receptor gamma ($\text{PPAR}\gamma$), a fatty acid-activated transcription factor. Although EPA and other ligands of $\text{PPAR}\gamma$, such as troglitazone and ciglitazone, inhibit cell proliferation, they do so in a $\text{PPAR}\gamma$ -independent manner (Palakurthi et al. (2000) *Cancer Research*, 60:2919; and Palakurthi et al. (2001) *Cancer Research*, 61:6213, incorporated herein by reference in their entirety for all purposes).
- [08] Embodiments of the present invention are directed to compounds that inhibit translation initiation, and the use of such compounds for treating (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infections are disclosed. Certain examples are directed to the use of a combination of the compounds described herein for treating (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infections.

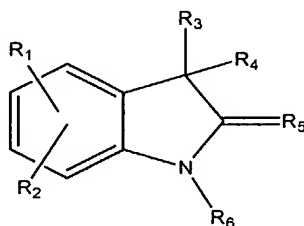
- [09] In at least certain examples, DAO compounds are provided. The terms “diaryloxindole” AND “DAO” are intended to include substituted diphenyloxindole compounds such as, for example, 3-(5-tert-butyl-2-hydroxy-phenyl)-3-phenyl-1,3-dihydro-indol-2-one-type compounds. In one example, diaryloxindole compounds of the present invention are set forth in Formula I. In certain examples, the diaryloxindole compounds of the present invention deplete intracellular calcium stores. In another example, diaryloxindole compounds are effective to inhibit translation initiation. In one aspect, the diaryloxindole compounds of the present invention include compounds comprising Formula I to Formula XIV, and/or the active and partially active compounds set forth in Tables 1 – 14 and Figures 4A-4B.
- [10] In accordance with a method aspect, a method of treating a proliferative disorder by providing and/or administering a diaryloxindole compound to a mammal, e.g., a human or a non-human (e.g., a non-human primate), is provided. In one example, the proliferative disorder is cancer. In accordance with other examples, a method of treating a viral infection by providing and/or administering a diaryloxindole compound to a mammal, e.g. a human or a non-human mammal, is provided.
- [11] In accordance with an additional aspect, kits are provided for the treatment of (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infections. In one aspect, the kits comprise a diaryloxindole compound, a pharmaceutically acceptable carrier, and optionally, instructions for use. The pharmaceutical composition can be administered to a human subject or a non-human subject depending on the disorder to be treated.
- [12] It will be recognized by the person of ordinary skill in the art that the compounds, compositions, methods and kits disclosed herein provide significant advantages over prior technology. Compounds, compositions, methods and kits can be designed or selected to relieve and/or alleviate symptoms in a patient suffering from one or more disorders. These and other aspects and examples are described below.

BRIEF DESCRIPTION OF THE DRAWINGS

- [13] The foregoing and other features and advantages of the present invention will be more fully understood from the following detailed description of illustrative embodiments taken in conjunction with the accompanying drawings.
- [14] *Figure 1* depicts a schematic of the anti-cancer mechanism of action for translation initiation inhibitors such as clotrimazole (CLT) and diaryloxindole (DAO).
- [15] *Figures 2A-2B* depict compound 1181 activity. (A) depicts calcium (Ca^{2+}) release in a dose dependent manner as compared to CLT from intracellular stores measured using dye-loaded cells. (B) depicts depletion of endoplasmic reticulum (ER) Ca^{2+} in stable cells lines carrying ER-targeted Ca^{2+} -sensitive chameleon proteins exposed to compound 1181, in accordance with certain examples. These proteins emit light and the Ca^{2+} content is measured by fluorescent resonance energy transfer (FRET).
- [16] *Figures 3A-3C* depict compound 1181 activity. (A) depicts the drug induced phosphorylation of eIF2 α protein in control (lane 1), positive control (lane 2) and 1181 (lane 3) measured using Western blot analysis. (B) shows the *in vitro* anti-cancer effect of 1181 in human lung cancer cells (A549) measured using sulfur rhodamine B (SRB) assay. (C) graphically depicts depletion of ternary complex in transgenic KLN cells exposed to compound 1181.
- [17] *Figures 4A-4B* depict a general schematic for the synthesis of peptides that contain the diaryloxindole moiety.
- [18] *Figure 5* graphically depicts a decrease in squamous cell carcinoma (KLN) tumor mass from DBA/2J mice after six weeks of treatment by oral administration with compound 1181 at 320 mg/kg/day.
- [19] It will be recognized that the results and examples in the figures are only illustrative and other examples and illustrations will be readily recognized by the person of ordinary skill in the art, given the benefit of this disclosure.



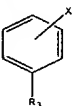
DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

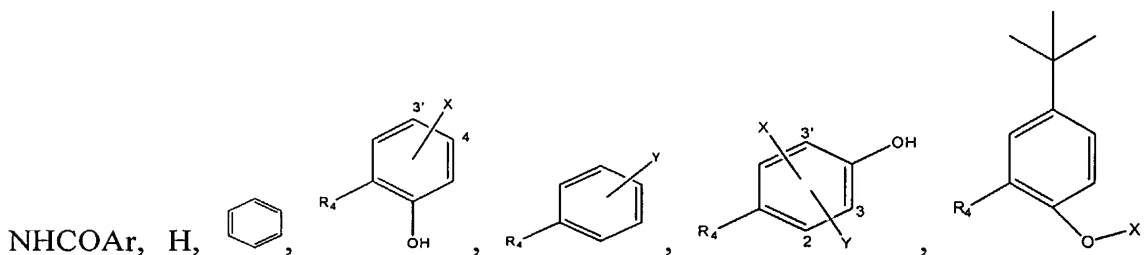
- [20] In accordance with certain examples, diaryloxindole compounds that inhibit translation (e.g., translation initiation) are provided. Such compounds are useful for the treatment of (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infections.
- [21] Certain examples are described below with reference to various chemical formulae. The chemical formulae referred to herein can exhibit the phenomena of tautomerism, conformational isomerism, stereo isomerism or geometric isomerism. As the formulae drawings within this specification can represent only one of the possible tautomeric, conformational isomeric, enantiomeric or geometric isomeric forms, it should be understood that the invention encompasses any tautomeric, conformational isomeric, enantiomeric or geometric isomeric forms which exhibit biological or pharmacological activity as described herein.
- [22] The compounds and compositions provided below are effective to inhibit translation (e.g., translation initiation) at least to the extent necessary for effective treatment of one or more disorders described herein. While in certain examples translation may be substantially inhibited such that little or no activity results, in other examples the inhibition is at least sufficient to relieve and or alleviate the symptoms from a selected disorder to be treated.
- [23] In accordance with certain embodiments, compounds of the invention are represented by the generic formula set forth below.

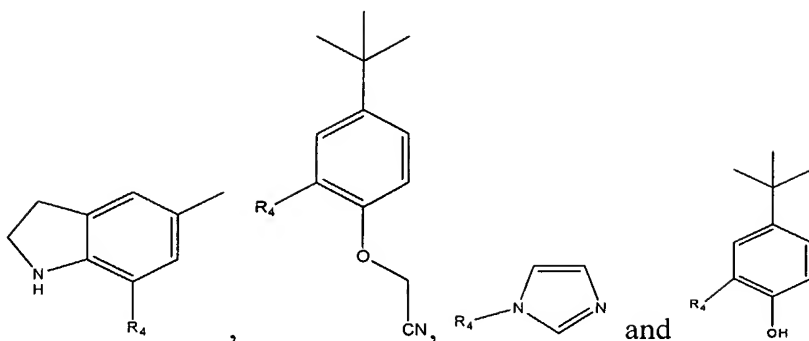


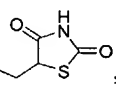
- [24] In accordance with certain aspects, R₁ is selected from the group consisting of (halo)alkyl, (un)substituted (alkyl)aryl, halogen, CN, COOH, alkenyl, alkynyl, alkoxy, cycloalkoxy, H, 2-OH, 2-Me, 2-OMe, 2-CH₂CO₂H, 2-NHFmoc, 2-NHSO₂CH₂Ph

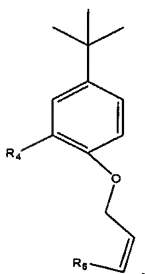
(wherein Ph is phenyl), 2-NHSO₂CH₃, 2-NHSO₂(4-*t*Bu)Ph, 2-NHSO₂(4-NHAc)Ph, 2-NHSO₂(3-CF₃)Ph, 2-NHSO₂(4-NO₂)Ph, 2-NHSO₂(4-OMe)Ph, 2-NHSO₂(4-Br)Ph, 2-NHSO₂(4-I)Ph, 2-NHSO₂(4-Ph)Ph, 2-NHSO₂(4-OPh)Ph, 2-NHAc, 2-NHCO(4-*t*Bu)Ph, 3-O(CH₂)₄NMe₂, 3-O(CH₂)₄N₃, 3-*t*-Bu, 3-OMe, 3-Cl, 3-F, 3-Me, 3-*t*-Bu, 3'-NHSO₂(4-*t*Bu)Ph, 4-Cl, 4-F, 4-Br, 4-OH, 4-Et, 4-O(CH₂)₃CHCH₂, 4-*n*-propyl, 4-*i*-Bu, 4-*n*-Bu, 4-O(CH₂)₂OH, 4-OMe, 4-*t*-Bu, 4-OPh, 4-Ph, 4-NMe₂, 4-ethyl, 5-Br, 5-Cl, 5-I, 5-sulfonic acid, 5-nitro, 5-ethyl, 5-fluoro, 5-OCF₃, 5-NO₂, 5-OMe, 5-NH₂, 5-Et, 5-F, 5-N₃, 5-NHSO₂-1-naphthyl, 6-ethyl, 6-Br, H, 6-Et, 6-Cl, 7-ethyl, 7-COOH, 7-COOMe, 7-Br, 7-CF₃, 7-OMe, 7-I and 7-Et; R₂ is selected from the group consisting of (halo)alkyl, (un)substituted (alkyl)aryl, halogen, CN, COOH, alkenyl, alkynyl, alkoxy, cycloalkoxy, H, 2-Me and 2-OMe, 2-OH, 3-Cl, 3-F, 3-Me, 4-F, 4-O(CH₂)₃CHCH₂, 4-OH, 4-*t*-Bu, 4-O(CH₂)₃CHCH₂, 7-formamide-N-[2-(4-Amino-phenyl)-ethyl], 7-COOH, 7-CH₂OH and 7-CH₂-N-imidazole; R₃ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted

heteroaromatic, Ar-NHSO₂Ar, Ar-NHCOAr, H, , , , 2-thiophene, -(CH₂)₁₁CH₃, -CH₂Ph, -CCH, -cyclohexyl and -C₆F₅, wherein X is selected from the group consisting of H, 2-OH, 2-OMe, 2-Me, 2-OMe, 2-OH, 2-CH₂CO₂H, 3-OMe, 3-Cl, 3-F, 3-Me, 3-O(CH₂)₄NMe₂, 3-O(CH₂)₄N₃, 3-*t*-Bu, 4-F, 4-O(CH₂)₃CHCH₂, 4-OH, 4-*n*-propyl, 4-*i*-Bu, 4-*n*-Bu, 4-O(CH₂)₂OH, 4-OMe, 4-*t*-Bu, 4-OMe, 4-OPh, 4-Ph, and 4-NMe₂; R₄ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar, Ar-

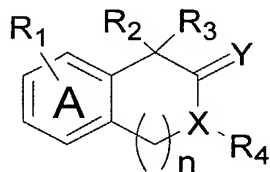




, R_4 —CN, R_4 —N and R_4 —OH, wherein X is selected from the group consisting of H, $-\text{SO}_2\text{-Camphor}$, $-\text{CO}(\text{CH}_2)_6\text{COOH}$, $-\text{CO}(\text{CH}_2)_3\text{CONHOH}$, $-\text{CH}_2\text{CH}_2\text{NHBoc}$, $-\text{CO}(\text{CH}_2)_3\text{COOH}$, $-\text{CH}_2\text{COOH}$, $-\text{CH}_2\text{CO-Leu-Phe-CH}_2\text{OH}$, $-\text{CH}_2\text{COOMe}$, 2-OH, 2-Me, 2-NHfmoc, 2-NHSO₂CH₂Ph, 2-NHSO₂CH₃, 2-NHSO₂(4-*t*Bu)Ph, 2-NHSO₂(4-NHAc)Ph, 2-NHSO₂(3-CF₃)Ph, 2-NHSO₂(4-NO₂)Ph, 2-NHSO₂(4-OMe)Ph, 2-NHSO₂(4-Br)Ph, 2-NHSO₂(4-I)Ph, 2-NHSO₂(4-Ph)Ph, 2-NHSO₂(4-OPh)Ph, 2-NHAc, 2-NHCO(4-*t*Bu)Ph, 3'-CH₂CH(CO₂Me)NH₂, 3'-CH₂CH(CO₂Me)NHfmoc, 3'-*t*-Bu, 3'-*t*-Bu, 3'-OH, 3'-O(CH₂)₃CHCH₂, 3'-O(CH₂)₄Br, 3'-O(CH₂)₄NMe₂, 3'-O(CH₂)₄N₃, 3'-, 3'-O(CH₂)₄NH₂, 3'-CF₃, 3'-CH₃, 3'-*n*-heptyl, 3'-*n*-nonyl, 3'-*i*-Bu, 3'-*i*-Propyl, 3'-*n*-Propyl, 3'-*n*-Octyl, 3'-Et, 3'-*n*-pentyl, 3'-*n*-Bu, 3'-*n*-hexyl, 3'-*n*-cyclopentyl, 3'-*n*-cyclohexyl, 3'-NHSO₂(4-*t*Bu)Ph, 3'-Me, 3-F, 3-CF₃, 4-NHSO₂(4-*t*Bu)Ph, 4-OH and 4-*t*-Bu, and wherein Y is selected from the group consisting of H, 4-OH 4-*t*-Bu, and 3'-NHSO₂(4-*t*Bu)Ph; R₅ is selected from the group consisting of O, NH and CH₂; and R₆ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar, Ar-NHCOAr, H, Ph, Me, $-\text{CH}_2\text{-(4-Cl)Ph}$, $-\text{CH}_2\text{CHCH}_2$, $-\text{CH}_2\text{OH}$, CH_2COOH , $\text{CH}_2\text{OCH}_2\text{CHCH}_2$, $-\text{SO}_2\text{(4-O-*n*-Bu)Ph}$, $-\text{SO}_2\text{(4-O-Ph)Ph}$, $-\text{SO}_2\text{(4-NHAc)Ph}$, $-\text{SO}_2\text{(4-CH}_2\text{CH}_2\text{CO}_2\text{Me)Ph}$, $-\text{SO}_2\text{(4-OMe)Ph}$, $-\text{SO}_2\text{(4-*t*-Bu)Ph}$, and $R_6\text{---CN}$. In another aspect, R₄ and R₆ are covalently linked via

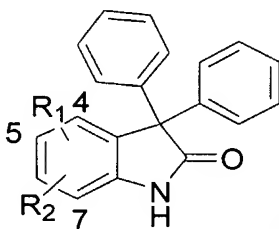


- [25] In accordance with a first example, diaryloxindole compounds are represented by Formula I, set forth below.



Formula I

- [26] In at least certain examples, A is selected from the group consisting of carbocyclic aromatic ring, heterocyclic ring and heteroaromatic ring, R₁ is selected from the group consisting of (halo)alkyl, (un)substituted (alkyl)aryl, halogen, CN, COOH, alkenyl, alkynyl, alkoxy and cycloalkoxy, R₂ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr, R₃ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr, R₄ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr, X is selected from the group consisting of unsubstituted or substituted nitrogen, oxygen, sulfur and carbon, Y is selected from the group consisting of unsubstituted or substituted nitrogen, oxygen, sulfur and carbon; and n = 0-4.
- [27] In accordance with a second example, diaryloxindole compounds are represented by Formula II, set forth below.

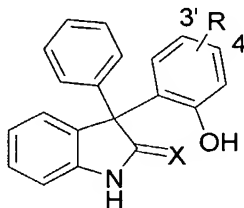


Formula II

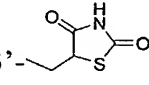
- [28] In at least certain examples, R₁ is selected from the group consisting of H, 5-bromo, 5-chloro, 7-bromo, 5-iodo, 5-OCF₃, 5-sulfonic acid, 5-nitro, 4-bromo, 6-bromo, 5-ethyl, 7-ethyl, 4-ethyl, 6-ethyl, 7-iodo, 5-fluoro, 7-COOH and 7-COOMe, and R₂ is H.

In other examples, R_1 is 4-Cl and R_2 is selected from the group consisting of 7-formamide-N-[2-(4-Amino-phenyl)-ethyl], 7-COOH, 7-CH₂OH and 7-CH₂-N-imidazole.

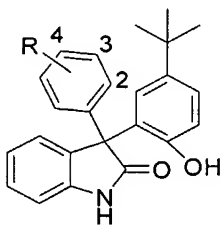
- [29] In accordance with a third example, diaryloxindole compounds are represented by Formula III, set forth below.



Formula III

- [30] In at least certain examples, X is selected from the group consisting of oxygen, NH and CH₂, and R is selected from the group consisting of 3'-CH₂CH(CO₂Me)NH₂, 3'-CH₂CH(CO₂Me)NHFmoc, 3'-*t*-Bu, 3'-*t*-Bu, 3'-OH, 3'-O(CH₂)₃CHCH₂, 3'-O(CH₂)₄Br, 3'-O(CH₂)₄NMe₂, 3'-O(CH₂)₄N₃, 3'-, 3'-O(CH₂)₄NH₂, 3'-CF₃, 3'-CH₃, 3'-*n*-heptyl, 3'-*n*-nonyl, 3'-*i*-Bu, 3'-*i*-Propyl, 3'-*n*-Propyl, 3'-*n*-Octyl, 3'-Et, 3'-*n*-pentyl, 3'-*n*-Bu, 3'-*n*-Hexyl, 3'-*n*-cyclopentyl, 3'-*n*-cyclohexyl, 4-NHSO₂(4-*t*Bu)Ph and 3'-NHSO₂(4-*t*Bu)Ph.

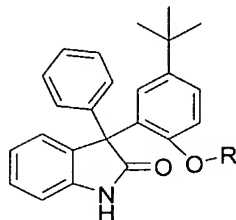
- [31] In accordance with a fourth example, diaryloxindole compounds are represented by Formula IV, set forth below.



Formula IV

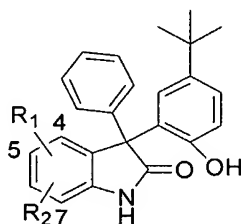
- [32] In at least certain examples, R is selected from the group consisting of 4-F, 4-O(CH₂)₃CHCH₂, 3-Cl, 3-F, 3-Me, 2-Me and 2-OMe.

- [33] In accordance with a fifth example, diaryloxindole compounds are represented by Formula V, set forth below.



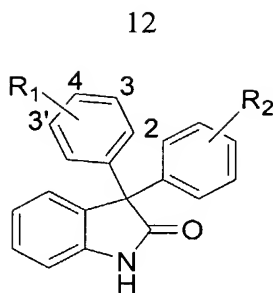
Formula V

- [34] In at least certain examples, R is selected from the group consisting of -SO₂-camphor, -CO(CH₂)₆COOH, -CO(CH₂)₃CONHOH, -CH₂CH₂NHBoc, -CO(CH₂)₃COOH, -CH₂COOH, -CH₂CO-Leu-Phe-CH₂OH and -CH₂COOMe.
- [35] In accordance with a sixth example, diaryloxindole compounds are represented by Formula VI, set forth below.



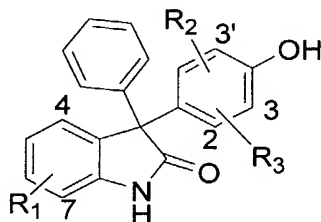
Formula VI

- [36] In at least certain examples, R₁ is selected from the group consisting of 7-Br, 4-Cl, 5-Br, 5-NO₂, 5-I, 5-OMe, 5-Cl, 7-CF₃, 5-NH₂, 4-Br, 6-Br, H, 7-OMe, 7-I, 5-Et, 7-Et, 4-Et, 6-Et, 5-F, 5-N₃, 7-COOH, 4-Cl, 6-Cl and 5-NHSO₂-1-naphthyl, and R₂ is H. In other examples, R₁ is 4-Cl and R₂ is 7-COOH.
- [37] In accordance with a seventh example, diaryloxindole compounds are represented by Formula VII, set forth below.



Formula VII

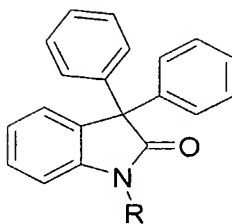
- [38] In at least certain examples, R_1 is selected from the group consisting of H, 2-OH, 3-O(CH₂)₄NMe₂, 3-O(CH₂)₄N₃, 3-*t*-Bu, 2-OMe, 3-OMe, 4-OH, 4-*n*-propyl, 4-*i*-Bu, 4-*n*-Bu, 4-O(CH₂)₂OH, 4-OMe, 2-CH₂CO₂H and 4-*t*-Bu, and R_2 is H. In other examples, R_1 is selected from the group consisting of 2-OH, 4-OMe, 3-*t*-Bu, 2-OMe, 2-OH, 4-OH, 4-OPh, 4-Ph and 4-NMe₂, and R_2 is selected from the group consisting of 2-OH, 4-OH and 4-*t*-Bu.
- [39] In accordance with an eighth example, diaryloxindole compounds are represented by Formula VIII, set forth below.



Formula VIII

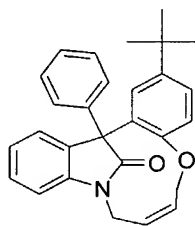
- [40] In at least certain examples, R_1 is selected from the group consisting of H and 7-COOH, R_2 is selected from a group consisting of H, 2-Me, 3'-Me, 3-F and 3-CF₃, and R_3 is selected from a group consisting of H, 2-NHFmoc, 2-NHSO₂CH₂Ph, 2-NHSO₂CH₃, 2-NHSO₂(4-*t*Bu)Ph, 2-NHSO₂(4-NHAc)Ph, 2-NHSO₂(3-CF₃)Ph, 2-NHSO₂(4-NO₂)Ph, 2-NHSO₂(4-OMe)Ph, 2-NHSO₂(4-Br)Ph, 2-NHSO₂(4-I)Ph, 2-NHSO₂(4-Ph)Ph, 2-NHSO₂(4-OPh)Ph, 2-NHAc, 2-NHCO(4-*t*Bu)Ph and 3'-NHSO₂(4-*t*Bu)Ph.
- [41] In accordance with a ninth example, diaryloxindole compounds are represented by Formula IX, set forth below.

13

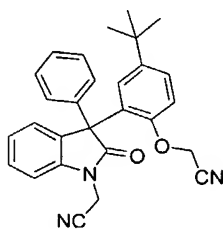


Formula IX

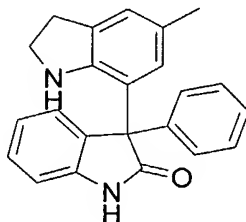
- [42] In at least certain examples, R is selected from the group consisting of Ph, Me, -CH₂-(4-Cl)Ph, -CH₂CHCH₂, -CH₂OH, CH₂COOH, CH₂OCH₂CHCH₂, -SO₂(4-O-n-Bu)Ph, -SO₂(4-O-Ph)Ph, -SO₂(4-NHAc)Ph, -SO₂(4-CH₂CH₂CO₂Me)Ph, -SO₂(4-OMe)Ph and -SO₂(4-*t*-Bu)Ph.
- [43] In accordance with a tenth example, diaryloxindole compounds are represented by Formulae X-XII, set forth below.



Formula X

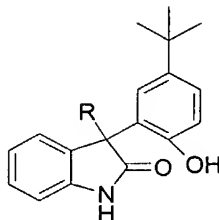


Formula XI



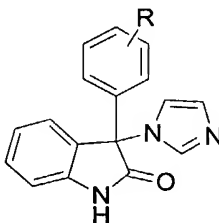
Formula XII

- [44] In accordance with an eleventh example, diaryloxindole compounds are represented by Formula XIII, set forth below.



Formula XIII

- [45] In at least certain examples, R is selected from the group consisting of 2-thiophene, $-(CH_2)_{11}CH_3$, $-CH_2Ph$, $-CCH_3$, -cyclohexyl and $-C_6F_5$ (pentafluorophenyl).
- [46] In accordance with a twelfth example, diaryloxindole compounds are represented by Formula XIV, set forth below.



Formula XIV

- [47] In at least certain examples, R is selected from the group consisting of H, 3-Cl, 3-F, 3-Me and 3-*t*-Bu.
- [48] In accordance with other examples, diaryloxindole compounds include, but are not limited to, compounds comprising Formula I to Formula XIV, and the active and/or partially active compounds set forth in Figures 4A-4B and Tables 1-14.
- [49] In at least certain examples, the compounds disclosed here can be used in the treatment of cellular proliferative disorders, such as cancer. Treatment of cellular proliferative disorders is intended to include, but is not limited to, inhibition of proliferation including rapid proliferation. As used herein, the term “cellular proliferative disorder” includes, but is not limited to, disorders characterized by

undesirable or inappropriate proliferation of one or more subset(s) of cells in a multicellular organism. The term “cancer” refers to various types of malignant neoplasms, most of which can invade surrounding tissues, and may metastasize to different sites (see, for example, PDR Medical Dictionary 1st edition (1995), incorporated herein by reference in its entirety for all purposes). The terms “neoplasm” and “tumor” refer to an abnormal tissue that grows by cellular proliferation more rapidly than normal and continues to grow after the stimuli that initiated proliferation is removed. *Id.* Such abnormal tissue shows partial or complete lack of structural organization and functional coordination with the normal tissue which may be either benign (i.e., benign tumor) or malignant (i.e., malignant tumor).

- [50] The language “treatment of cellular proliferative disorders” is intended to include, but is not limited to, the prevention of the growth of neoplasms in a subject or a reduction in the growth of pre-existing neoplasms in a subject. The inhibition also can be the inhibition of the metastasis of a neoplasm from one site to another. In certain embodiments, the neoplasms are sensitive to one or more diaryloxindole compounds of the present invention. Examples of the types of neoplasms intended to be encompassed by the present invention include, but are not limited to, those neoplasms associated with cancers of the breast, skin, bone, prostate, ovaries, uterus, cervix, liver, lung, brain, larynx, gallbladder, pancreas, rectum, parathyroid, thyroid, adrenal gland, immune system, neural tissue, head and neck, colon, stomach, bronchi, and/or kidneys.
- [51] In accordance with certain other examples, methods for treating viral infections are also disclosed. Treatment of viral infections is intended to include, but is not limited to, the use of a diaryloxindole compound described herein to prevent the initiation of viral protein synthesis. The term “viral infection,” as used herein, refers to one or more cells which have been infected with a virus, such as a DNA or RNA animal virus. As used herein, RNA viruses include, but are not limited to, virus families such as picornaviridae (e.g., polioviruses), reoviridae (e.g., rotaviruses), togaviridae (e.g., encephalitis viruses, yellow fever virus, rubella virus), orthomyxoviridae (e.g., influenza viruses), paramyxoviridae (e.g., respiratory syncytial virus, measles virus,

mumps virus, parainfluenza virus), rhabdoviridae (e.g., rabies virus), coronaviridae, bunyaviridae, flaviviridae, filoviridae, arenaviridae, bunyaviridae, and retroviridae (e.g., human T-cell lymphotropic viruses (HTLV), human immunodeficiency viruses (HIV)). As used herein, DNA viruses include, but are not limited to, virus families such as papovaviridae (e.g., papilloma viruses), adenoviridae (e.g., adenovirus), herpesviridae (e.g., herpes simplex viruses), and poxviridae (e.g., variola viruses). In certain embodiments, the viral infection is caused by hepatitis B virus, hepatitis C virus, and/or HIV.

- [52] In accordance with other examples, methods for treating disorders associated with viral infections are disclosed. Treatment of one or more disorders associated with viral infections is intended to include, but is not limited to, the use of a diaryloxindole compound described herein to reduce or alleviate one or more symptoms of a viral infection. As used herein, the term “disorders associated with viral infection” refers to the host’s response to infection by one or more viruses. Such responses include, but are not limited to neurological symptoms (e.g., encephalitis, meningoencephalitis, paralysis, myelopathy, neuropathy, aseptic meningitis, hemiparesis, dementia, dysphagia, lack of muscular coordination, impaired vision, coma, and the like), wasting symptoms (e.g., inflammatory cell infiltration, perivascular cuffing of blood vessels, demyelination, necrosis, reactive gliosis and the like), gastroenteritis symptoms (e.g., diarrhea, vomiting, cramps and the like), hepatitis symptoms (nausea, vomiting, right upper quadrant pain, raised liver enzyme levels (e.g., AST, ALT and the like), jaundice and the like), hemorrhagic fever symptoms (e.g., headache, fever, chills body pains, diarrhea, vomiting, dizziness, confusion, abnormal behavior, pharyngitis, conjunctivitis, red face, red neck, hemorrhage, organ failure and the like), oncogenic symptoms (e.g., sarcomas, leukemias and the like, as well as “rare” malignancies, e.g., Kaposi’s sarcoma, oral hairy leukoplakia, lymphomas and the like), immunodeficiency symptoms (e.g., opportunistic infections, wasting, rare malignancies, neurological disease, fever, diarrhea, skin rashes and the like), lesions (e.g., warts (e.g., common wart, flat wart, deep hyperkeratotic palmoplantar wart, superficial mosaic type palmoplantar wart and the like), epidermodysplasia, mucosal lesions, ulcers and the like), and systemic symptoms (e.g., fever, chills, headache, muscle pain, bone pain, joint pain, pharyngitis, tonsillitis, sinusitis, otitis, bronchitis,

pneumonia, bronchopneumonia, nausea, vomiting, increased salivation, rash, macules, lymphadenopathy, arthritis, ulcers, photosensitivity, weight loss, irritability, restlessness, anxiety, coma, death and the like). Disorders associated with viral infections are described in *Fields Virology* 4th Ed. (2001) Lippincott, Williams & Wilkins, and the introduction to medical virology website (web.uct.ac.za/depts./mmi/jmoodie/introvi2.html), incorporated herein by reference in their entirety for all purposes.

- [53] In accordance with other examples, methods for treating non-proliferative, degenerative disorders associated with aberrant translation initiation using a diaryloxindole compound described herein to alleviate and/or reduce one or more symptoms associated with a non-proliferative, degenerative disorder are disclosed. Treatment of non-proliferative, degenerative diseases is intended to include, but is not limited to, the use of diaryloxindole compounds. As used herein, the term “non-proliferative degenerative disorder” is intended to include, but is not limited to, diseases characterized by a loss of function of cells, tissues, and/or organs due to aberrant translation initiation. Non-proliferative degenerative disorders include, but are not limited to, disorders such as Alzheimer’s disease and insulin resistance.
- [54] The term “calcium releaser,” as used herein, refers to molecules which cause a sustained depletion of intracellular Ca^{2+} stores and inhibit translation initiation. Calcium releasers include, but are not limited to, molecules such as clotrimazole (CLT), fatty acids such as EPA, diaryloxindole compounds of the present invention (including, but not limited to compounds comprising Formula I to Formula XIV and the active and/or partially active compounds set forth in Figures 4A-4B and Tables 1-14), and the like.
- [55] In accordance with certain other examples, kits for treating one or more (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infections are provided. In one example, the kit may comprise one or more diaryloxindole compounds, or a combination of one or more diaryloxindole compounds. In another example, the kit may comprise a pharmaceutically acceptable carrier. In an additional example, the kit may also include instructions for treating (1) proliferative disorders, (2) non-

proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infections. In some examples, the kit may also comprise, e.g., a buffering agent, a preservative, or a protein stabilizing agent. In other examples, the kit may also contain a control sample or a series of control samples which can be assayed and compared to the test sample contained. Other suitable components for including in the kit will be selected by the person of ordinary skill in the art, given the benefit of this disclosure.

- [56] In accordance with certain examples, diaryloxindole compounds can be incorporated into pharmaceutical compositions suitable for administration. Such compositions typically comprise the compounds disclosed here and a pharmaceutically acceptable carrier. As used herein the term “pharmaceutically acceptable carrier” is intended to include any and all solvents, dispersion media, coatings, antibacterial and antifungal agents, isotonic and absorption delaying agents, and the like, compatible with pharmaceutical administration. The use of such media and agents for pharmaceutically active substances is well known in the art. Except insofar as any conventional media or agent is incompatible with the active compound, use thereof in the compositions is contemplated. Supplementary active compounds can also be incorporated into the compositions.
- [57] In accordance with certain examples, a pharmaceutical composition of the invention is formulated to be compatible with its intended route of administration. Such pharmaceutical compositions may be administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously, intravenously or other suitable methods that will be readily selected by the person of ordinary skill in the art, given the benefit of this disclosure. For example, solutions or suspensions used for parenteral, intradermal, or subcutaneous application can include the following components: a sterile diluent such as water for injection, saline solution, fixed oils, polyethylene glycols, glycerin, propylene glycol or other synthetic solvents; antibacterial agents such as benzyl alcohol or methyl parabens; antioxidants such as ascorbic acid or sodium bisulfite; chelating agents such as ethylenediaminetetraacetic acid; buffers such as acetates, citrates or phosphates and agents for the adjustment of tonicity such as sodium chloride or dextrose. pH can be

adjusted with acids or bases, such as hydrochloric acid or sodium hydroxide. The parenteral preparation can be enclosed in ampules, disposable syringes or multiple dose vials made of glass or plastic.

[58] In accordance with other examples, pharmaceutical compositions suitable for injectable use include sterile aqueous solutions (where water soluble) or dispersions and sterile powders for the extemporaneous preparation of sterile injectable solutions or dispersion. For intravenous administration, suitable carriers include physiological saline, bacteriostatic water, CREMPHOR ELTM (BASF, Parsippany, N.J.), or phosphate buffered saline (PBS). In all cases, the composition must be sterile and should be fluid to the extent that easy syringability exists. It must be stable under the conditions of manufacture and storage and must be preserved against the contaminating action of microorganisms such as bacteria and fungi. The carrier can be a solvent or dispersion medium containing, for example, water, ethanol, polyol (for example, glycerol, propylene glycol, and liquid polyethylene glycol, and the like), and suitable mixtures thereof. The proper fluidity can be maintained, for example, by the use of a coating such as lecithin, by the maintenance of the required particle size in the case of dispersion and by the use of surfactants. Prevention of the action of microorganisms can be achieved by various antibacterial and antifungal agents, for example, parabens, chlorobutanol, phenol, ascorbic acid, thimerosal, and the like. In many cases, it will be preferable to include isotonic agents, for example, sugars, polyalcohols such as manitol, sorbitol, sodium chloride in the composition. Prolonged absorption of the injectable compositions can be brought about by including in the composition an agent which delays absorption, for example, aluminum monostearate and gelatin.

[59] In accordance with other examples, sterile injectable solutions can be prepared by incorporating the active compound in the required amount in an appropriate solvent with one or a combination of ingredients enumerated above, as required, followed by filtered sterilization. Generally, dispersions are prepared by incorporating the active compound into a sterile vehicle which contains a basic dispersion medium and the required other ingredients from those enumerated above. In the case of sterile powders for the preparation of sterile injectable solutions, methods of preparation can

be vacuum drying and freeze-drying which yields a powder of the active ingredient plus any additional desired ingredient from a previously sterile-filtered solution thereof. Oral compositions generally include an inert diluent or an edible carrier. They can be enclosed in gelatin capsules or compressed into tablets. For the purpose of oral therapeutic administration, the active compound can be incorporated with excipients and used in the form of tablets, troches, or capsules. Oral compositions can also be prepared using a fluid carrier for use as a mouthwash, wherein the compound in the fluid carrier is applied orally and swished and expectorated or swallowed. Pharmaceutically compatible binding agents, and/or adjuvant materials can be included as part of the composition. The tablets, pills, capsules, troches and the like can contain any of the following ingredients, or compounds of a similar nature: a binder such as microcrystalline cellulose, gum tragacanth or gelatin; an excipient such as starch or lactose, a disintegrating agent such as alginic acid, Primogel, or corn starch; a lubricant such as magnesium stearate or Sterotes; a glidant such as colloidal silicon dioxide; a sweetening agent such as sucrose or saccharin; or a flavoring agent such as peppermint, methyl salicylate, or orange flavoring.

- [60] In at least certain examples, the active compounds are prepared with carriers that will protect the compound against rapid elimination from the body, such as a controlled release formulation, including implants and microencapsulated delivery systems. Biodegradable, biocompatible polymers can be used, such as ethylene vinyl acetate, polyanhydrides, polyglycolic acid, collagen, polyorthoesters, and polylactic acid. Methods for preparation of such formulations will be apparent to those skilled in the art. The materials can also be obtained commercially from Alza Corporation and Nova Pharmaceuticals, Inc. Liposomal suspensions (including liposomes targeted to infected cells with monoclonal antibodies to viral antigens) can also be used as pharmaceutically acceptable carriers. These may be prepared according to methods known to those skilled in the art, for example, as described in U.S. Pat. No. 4,522,811, incorporated herein by reference in its entirety for all purposes.
- [61] In accordance with certain examples, pharmaceutical compositions of the invention comprise one or more diaryloxindole compounds covalently linked to a peptide (i.e., a polypeptide comprising two or more amino acids) (Figures 4A-4B). Peptides may be

assembled sequentially from individual amino acids or by linking suitable small peptide fragments. In sequential assembly, the peptide chain is extended stepwise, starting at the C-terminus, by one amino acid per step. In fragment coupling, fragments of different lengths can be linked together, and the fragments can also be obtained by sequential assembly from amino acids or by fragment coupling of still shorter peptides.

- [62] In both sequential assembly and fragment coupling it is necessary to link the units (e.g., amino acids, peptides, compounds and the like) by forming an amide linkage, which can be accomplished via a variety of enzymatic and chemical methods. The methods described herein for formation of peptidic amide linkages are also suitable for the formation of non-peptidic amide linkages.
- [63] Chemical methods for forming the amide linkage are described in detail in standard references on peptide chemistry, including Muller, *Methoden der organischen Chemie* Vol. XV/2, 1-364, Thieme Verlag, Stuttgart, (1974); Stewart and Young, *Solid Phase Peptide Synthesis*, 31-34 and 71-82, Pierce Chemical Company, Rockford, Ill. (1984); Bodanszky et al., *Peptide Synthesis*, 85-128, John Wiley & Sons, New York, (1976); *Practice of Peptide Synthesis*, M. Bodansky, A. Bodansky, Springer-Verlag, 1994 and other standard works in peptide chemistry, incorporated herein by reference in their entirety for all purposes. Methods include the azide method, the symmetric and mixed anhydride method, the use of in situ generated or preformed active esters, the use of urethane protected N-carboxy anhydrides of amino acids and the formation of the amide linkage using coupling reagents, such as dicyclohexylcarbodiimide (DCC), diisopropylcarbodiimide (DIC), 1-ethoxycarbonyl-2-ethoxy-1,2-dihydroquinoline (EEDQ), pivaloyl chloride, 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride (EDCI), n-propane-phosphonic anhydride (PPA), N,N-bis (2-oxo-3-oxazolidinyl)amido phosphoryl chloride (BOP-Cl), bromo-tris-pyrrolidinophosphonium hexafluorophosphate (PyBrop), diphenylphosphoryl azide (DPPA), Castro's reagent (BOP, PyBop), O-benzotriazolyl-N,N,N',N'-tetramethyluronium salts (HBTU), O-azabenzotriazolyl-N,N,N',N'-tetramethyluronium salts (TATU), diethylphosphoryl cyanide (DEPCN), 2,5-diphenyl-2,3-dihydro-3-oxo-4-hydroxythiophene dioxide (Steglich's reagent;

HOTDO), 1,1'-carbonyldiimidazole (CDI) and the like. The coupling reagents can be employed alone or in combination with additives such as N,N-dimethyl-4-aminopyridine (DMAP), N-hydroxy-benzotriazole (HOBt), N-hydroxybenzotriazine (HOObt), N-hydroxysuccinimide (HOSu), 2-hydroxypyridine and the like.

- [64] In accordance with other examples, methods of modulating translation initiation for therapeutic purposes are disclosed. In one example, a method involves contacting a cell with an agent that inhibits translation initiation. An agent that inhibits translation initiation can be any one of the compounds described herein, such as a diaryloxindole compound. In at least certain examples, the compound modulates the depletion of intracellular calcium stores. Methods of modulating translation initiation can be performed *in vitro* (e.g., by culturing a cell with the agent) or, alternatively, *in vivo* (e.g., by administering the agent to a subject). Certain examples disclosed herein are directed to methods of treating an individual afflicted with a disease or disorder characterized by aberrant translation initiation. Examples of such disorders are described herein. In one embodiment, the method involves administering an agent (e.g., an agent identified by a screening assay described herein), or combination of agents that inhibits translation initiation. As used herein, an individual afflicted with a disease or disorder is intended to include both human and non-human mammals. Examples of non-human mammals include, but are not limited to, non-human primates, horses, cows, goats, sheep, dogs, cats, mice, rats, hamsters, guinea pigs and the like.
- [65] The present invention provides for both prophylactic and therapeutic methods of treating a subject for one or more (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infection. In one aspect, the invention provides a method for preventing in a subject, a disease or condition associated with one or more (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infection, by administering, to the subject one or more diaryloxindole compounds described herein to modulate one or more (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infection. Administration of a prophylactic agent can

occur prior to the manifestation of symptoms, such that a disease or disorder is prevented or, alternatively, delayed in its progression.

- [66] Another aspect of the invention pertains to therapeutic methods of treating one or more (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infection for therapeutic purposes. Accordingly, in an exemplary embodiment, a therapeutic method of the invention involves contacting a subject with a diaryloxindole compound that therapeutically treats one or more (1) proliferative disorders, (2) non-proliferative, degenerative disorders, (3) viral infections, and/or (4) disorders associated with viral infection.
- [67] One embodiment of the present invention involves a method of treating a translation initiation-associated disease or disorder which includes the step of administering a therapeutically and/or prophylactically effective amount of an agent which inhibits translation initiation to a subject. In another embodiment, a subject is administered a therapeutically and/or prophylactically effective amount that is effective to deplete intracellular calcium stores. As defined herein, a therapeutically and/or prophylactically effective amount of agent (i.e., an effective dosage) ranges from about 0.001 to 30 mg/kg body weight, from about 0.01 to 25 mg/kg body weight, from about 0.1 to 20 mg/kg body weight, from about 1 to 10 mg/kg, from about 2 to 9 mg/kg, from about 3 to 8 mg/kg, from about 4 to 7 mg/kg, or from about 5 to 6 mg/kg body weight. The skilled artisan will appreciate that certain factors may influence the dosage required to effectively treat a subject, including but not limited to the severity of the disease or disorder, previous treatments, the general health and/or age of the subject, and other diseases present. Treatment of a subject with a therapeutically and/or prophylactically effective amount of an inhibitor can include a single treatment or can include a series of treatments. It will also be appreciated that the effective dosage of in used for treatment may increase or decrease over the course of a particular treatment.

EXAMPLE I**General Synthetic Approach to Generate Diaryloxindole Compounds**

- [68] The general synthetic approaches to produce the diaryloxindole compounds of the present invention are set forth in Tables 1-14. Tables 1-14 depict biological data of compounds synthesized describing the general synthetic strategy for the scaffold set forth at the top of each table. The appropriate isatins were either commercially available or synthesized starting from appropriate anilines.
- [69] A bioassay guided iterative approach was taken for the synthesis of the diaryloxindole compounds. The iterative approach involved an initial selection of compounds which were subjected to one or more bioassays, such as those described in Example III. Additional compounds were then synthesized based on bioassay and/or structural (e.g., electronic and steric nature of various diaryloxindole compound substituents) data. The compounds synthesized addressed the electronics and the sterics by substituting the three phenyl rings and the nitrogen with various functional groups. The symmetric diphenyl compounds were obtained using triflic acid (TfOH) following previously reported procedures (Klumpp et al. (1998) *J. Org. Chem.*, 63:4481, incorporated herein by reference in its entirety for all purposes), while the unsymmetrical compounds were synthesized using a two step procedure. The first step involved a Grignard addition to isatin using appropriately substituted starting materials, and the key second step involved the generation of a quaternary center at the three position of the oxindole ring. This was accomplished by an acid catalyzed Friedel-Crafts type condensation of step B with the appropriate aromatic ring to generate diaryloxindoles (Hewawasam et al. (2002) *Bioorganic & Medicinal Chemistry Letters*, 12:1023, incorporated herein by reference in its entirety for all purposes). For activated ring systems that contained an electron-donating group, p-toluene sulfonic acid in dichloroethane allowed the condensation to occur smoothly, while the unactivated ring systems required the use of triflic acid, which is much stronger than p-toluene sulfonic acid.
- [70] As a non-limiting example, compounds 1272 and 1273 (set forth in Table 1) were synthesized starting from 3-bromoaniline, which upon condensation with hydroxylamine and chloral hydrate followed by concentrated sulfuric acid yielded an

inseparable regioisomeric mixture of 4- and 6- bromo isatins. The addition of the two phenyl groups to the three position of the oxindole allowed easy chromatographic separation of the 4- and 6- bromo-3,3-diphenyloxindoles 1272 and 1273. Table 1 sets forth biological data for diaryloxindole compounds including, but not limited to 1272 and 1273. For Tables 1-14, Ca^{2+} refers to Ca^{2+} release from intracellular stores where a “+” denotes release and a “+/-” denotes inconclusive; eIF2 α -P refers to phosphorylation of eIF2 α measured by Western blot; SRB refers to the inhibitory concentration to reduce cell growth by 50% (IC_{50}) for growth inhibition of A549 lung cancer cells; and n.d. is not determined.

| <p>A) Chloral hydrate; $\text{NH}_2\text{OH}\cdot\text{HCl}$; HCl B) H_2SO_4 C) TfOH, C_6H_6</p> | | | | | |
|---|---------------------------|--------------------------------------|------------------|------------------|-----|
| | | | | | |
| Compound | R_1 | R_2 | Ca^{2+} | eIF2 α -P | SRB |
| 1205 | 5-Br | H | + | 2.05 | 9 |
| 1206 | 5-Cl | H | + | 1.58 | 9 |
| 1207 | 7-Br | H | +/- | 2.01 | 3 |
| 1263 | 5- OCF_3 | H | + | n.d. | 8 |
| 1264 | 5-I | H | + | 2.53 | 9 |
| 1265 | 5- NO_2 | H | +/- | 2.35 | 14 |
| 1266 | 5- SO_3H | H | - | 1.62 | 9 |
| 1267 | 7-I | H | - | 1.88 | 20 |
| 1268 | 7-Et | H | - | 2.19 | 14 |
| 1269 | 5-Et | H | + | 1.64 | >20 |
| 1270 | 4-Et | H | + | 1.68 | >20 |
| 1271 | 6-Et | H | + | 1.58 | 4 |
| 1272 | 4-Br | H | + | 1.63 | 8 |
| 1273 | 6-Br | H | + | 1.72 | 6 |
| 1350 | 5-F | H | + | 1.16 | 9 |
| 1351 | 4-Cl | 7- CO_2Me | +/- | 1.35 | >20 |
| 1353 | 7- CO_2H | H | - | 1.54 | >20 |
| 1354 | 7- CO_2Me | H | + | 1.74 | >20 |
| 1355 | 4-Cl | | +/- | 3.80 | 5 |
| 1392 | 4-Cl | 7- CO_2H | + | 2.76 | 4 |
| 1398 | 4-Cl | 7- CH_2OH | - | 1.48 | 14 |
| 1401 | 4-Cl | 7- $\text{CH}_2(\text{N-Imidazole})$ | +/- | 2.56 | >20 |

Table 1

| <p>A) PhMgBr B) H⁺; Substituted Phenol</p> | | | | | |
|---|--|----------------|------------------|---------|------|
| | | | | | |
| Compound | R | X | Ca ²⁺ | eIF2α-P | SRB |
| 1171 | 3'-CH ₂ CH(CO ₂ Me)NH ₂ | O | + | n.d. | n.d. |
| 1172 | 3'-CH ₂ CH(CO ₂ Me)NHFmoc | O | + | 1.94 | n.d. |
| 1181 | 3'- <i>t</i> -Bu | O | + | 5 | 3 |
| 1182 | 3'- <i>t</i> -Bu | H ₂ | + | n.d. | 12 |
| 1201 | 3'-OH | O | + | n.d. | 20 |
| 1202 | 3'-O(CH ₂) ₃ CHCH ₂ | O | + | n.d. | 6 |
| 1203 | 3'-O(CH ₂) ₄ Br | O | + | n.d. | 8 |
| 1216 | 3'-O(CH ₂) ₄ NMe ₂ | O | +/- | n.d. | >20 |
| 1219 | 3'-O(CH ₂) ₄ N ₃ | O | + | n.d. | 5 |
| 1220 | | O | +/- | n.d. | 16 |
| 1228 | 3'-O(CH ₂) ₄ NH ₂ | O | + | n.d. | 5 |
| 1243 | 3'-CF ₃ | O | - | n.d. | >20 |
| 1278 | 3'-CH ₃ | O | + | 3.33 | 8 |
| 1279 | 3'- <i>n</i> -heptyl | O | +/- | 3.49 | 3 |
| 1280 | 3'- <i>n</i> -nonyl | O | +/- | 3.89 | 3 |
| 1281 | 3'- <i>i</i> -Bu | O | + | 7.94 | 3 |
| 1282 | 3'- <i>i</i> -Propyl | O | + | 4.96 | 4 |
| 1283 | 3'- <i>n</i> -Propyl | O | + | 7.67 | 3 |
| 1284 | 3'- <i>n</i> -Octyl | O | - | 2.91 | 3 |
| 1285 | 3'-Et | O | + | 2.96 | 8 |
| 1286 | 3'- <i>n</i> -pentyl | O | + | 8.60 | 3 |
| 1287 | 3'- <i>n</i> -Bu | O | + | 10.08 | 3 |
| 1288 | 3'- <i>n</i> -Hexyl | O | + | 6.28 | 3 |
| 1289 | 3'- <i>n</i> -cyclopentyl | O | + | 6.49 | 3 |
| 1290 | 3'- <i>n</i> -cyclohexyl | O | +/- | 8.60 | 3 |
| 1624 | 4- NHSO ₂ (4- <i>t</i> Bu)Ph | O | + | n.d. | <1 |
| 1638 | 3'-NHSO ₂ (4- <i>t</i> Bu)Ph | O | + | n.d. | 3 |

Table 2

28

| <p>A) ArMgBr B) H⁺; 4-<i>t</i>-ButylPhenol</p> | | | | |
|---|--|------------------|------------------|-----|
| | | | | |
| Compound | R | Ca ²⁺ | eIF2 α -P | SRB |
| 1210 | 4-F | + | 1.86 | 4 |
| 1218 | 4-O(CH ₂) ₃ CHCH ₂ | - | 1.36 | 7 |
| 1221 | 3-Cl | + | 3.24 | 3 |
| 1223 | 3-F | + | 4.41 | 7 |
| 1224 | 3-Me | + | 1.74 | 9 |
| 1225 | 2-Me | + | 1.69 | 4 |
| 1226 | 2-OMe | + | 2.22 | 3 |

Table 3

| <p>A) PhMgBr B) H⁺; 4-<i>t</i>-ButylPhenyl substituted ether</p> | | | | |
|---|--|------------------|------------------|-----|
| | | | | |
| Compound | R | Ca ²⁺ | eIF2 α -P | SRB |
| 1319 | -SO ₂ -Camphor | + | n.d. | 2 |
| 1321 | -CO(CH ₂) ₆ COOH | + | n.d. | 16 |
| 1323 | -CO(CH ₂) ₃ CONHOH | + | n.d. | 3 |
| 1329 | -CH ₂ CH ₂ NHBoc | - | 0.89 | 3 |
| 1396 | -CO(CH ₂) ₃ COOH | - | 1.72 | 7 |
| 1397 | -CH ₂ COOH | + | 1.46 | 8 |
| 1400 | -CH ₂ CO-Leu-Phe-CH ₂ OH | + | 3.70 | 3 |
| 1402 | -CH ₂ CO ₂ Me | + | 3.94 | 9 |

Table 4

| <p>A) Chloral hydrate; $\text{NH}_2\text{OH}\cdot\text{HCl}$; HCl B) H_2SO_4 C) PhMgBr D) H^+; 4-<i>t</i>-ButylPhenol</p> | | | | | |
|---|---------------------------------|-------------------|------------------|------------------|-----|
| | | | | | |
| Compound | R_1 | R_2 | Ca^{2+} | eIF2 α -P | SRB |
| 1196 | H | 7-Br | + | n.d. | 3 |
| 1209 | H | 4-Cl | + | 2.08 | 8 |
| 1211 | H | 5-Br | + | 1.14 | 3 |
| 1212 | H | 5-NO ₂ | + | 1.28 | 4 |
| 1213 | H | 5-I | +/- | 2 | 3 |
| 1214 | H | 5-OMe | + | 1.62 | 6 |
| 1215 | H | 5-Cl | +/- | 1.1 | 3 |
| 1230 | H | 7-CF ₃ | +/- | 0.41 | 3 |
| 1231 | H | 5-NH ₂ | + | 1.46 | 14 |
| 1234 | H | 4-Br | + | 2.57 | 6 |
| 1235 | H | 6-Br | + | 3.2 | 4 |
| 1238 | 5-NHSO ₂ -1-naphthyl | H | +/- | n.d. | 3 |
| 1240 | H | 7-OMe | + | 1.04 | 8 |
| 1253 | H | 7-I | + | 2.05 | 6 |
| 1254 | H | 5-Et | + | 2.12 | 4 |
| 1256 | H | 7-Et | + | 1.3 | 3 |
| 1257 | H | 4-Et | + | 1.11 | 10 |
| 1258 | H | 6-Et | + | 3.13 | 4 |
| 1312 | H | 5-F | + | n.d. | 4 |
| 1348 | H | 5-N ₃ | + | n.d. | 3 |
| 1408 | H | 7-COOH | + | 2.08 | >20 |
| 1418 | 4-Cl | 7-COOH | + | 7.47 | 16 |
| 1428 | H | 4-Cl | + | n.d. | 3 |
| 1429 | H | 6-Cl | + | n.d. | 3 |

Table 5

| <p>A) ArMgBr B) H⁺; Substituted Phenyl</p> | | | | | |
|---|---|------------------------|------------------|---------|-----|
| | | | | | |
| Compound | R ₁ | R ₂ | Ca ²⁺ | eIF2α-P | SRB |
| 1162 | Me | Me | + | n.d. | 5 |
| 1163 | 2-OH; 4-OMe | 2-OH; 4-OMe | + | n.d. | 10 |
| 1194 | H | H | + | 2.5 | 13 |
| 1195 | 2-OH; 3'- <i>t</i> -Bu | 2-OH; 3'- <i>t</i> -Bu | + | n.d. | 3 |
| 1197 | 2-OH | H | + | 1.50 | 14 |
| 1199 | 2-OH; 3-O(CH ₂) ₄ NMe ₂ | H | + | n.d. | >20 |
| 1200 | 2-OH; 3-O(CH ₂) ₄ N ₃ | H | + | n.d. | 3 |
| 1208 | 4-Cl | 2-OH | + | 1.42 | 10 |
| 1217 | 3- <i>t</i> -Bu | H | + | 1.5 | 4 |
| 1232 | 3- <i>t</i> -Bu | 4-OH | + | n.d. | 4 |
| 1237 | 2-OMe | 4- <i>t</i> -Bu | + | 1.3 | 17 |
| 1239 | 2-OH | 4- <i>t</i> -Bu | + | 1.88 | 8 |
| 1240 | 4-OH | 4- <i>t</i> -Bu | + | 1.04 | 14 |
| 1259 | 4-OH | 4-OH | - | n.d. | >20 |
| 1260 | 4-OPh | 4-OH | + | n.d. | 12 |
| 1261 | 4-Ph | 4-OH | + | n.d. | 10 |
| 1262 | 4-NMe ₂ | 4-OH | +/- | n.d. | 10 |
| 1292 | 2-OMe | H | +/- | 1.04 | 9 |
| 1293 | 3-OMe | H | +/- | 1.30 | 14 |
| 1294 | 4-OMe | H | - | 1.52 | 10 |
| 1295 | 4-OH | H | + | 1.66 | 16 |
| 1296 | 4- <i>n</i> -propyl | H | + | n.d. | 11 |
| 1297 | 4- <i>i</i> -Bu | H | + | 0.7 | 8 |
| 1298 | 4- <i>n</i> -Bu | H | +/- | 0.45 | 8 |
| 1299 | 4-O(CH ₂) ₂ OH | H | + | 0.71 | 5 |
| 1327 | 4-OMe; 2-CH ₂ CO ₂ H | H | n.d. | n.d. | >20 |
| 1349 | 4- <i>t</i> -Bu | H | + | 1.27 | 8 |

Table 6

| <p>A) Chloral hydrate; NH₂OH.HCl; HCl B) H₂SO₄ C) PhMgBr D) H⁺; Substituted Phenol</p> | | | | | | |
|--|---------------------|-------------------|--|------------------|---------|------|
| | | | | | | |
| Compound | R ₁ | R ₂ | R ₃ | Ca ²⁺ | eIF2α-P | SRB |
| 1242 | H | 3-CF ₃ | H | + | 2.72 | 14 |
| 1244 | H | 3-F | H | + | 1.38 | 12 |
| 1394 | 7-CO ₂ H | 3'-Me | 2-NHFmoc | + | 8.21 | 9 |
| 1395 | H | 3'-Me | 2-NHFmoc | - | 1.84 | 3 |
| 1405 | H | 3'-Me | 2-NHSO ₂ CH ₂ Ph | + | 1.84 | 4 |
| 1417 | 7-CO ₂ H | 3'-Me | 2-NHSO ₂ CH ₃ | + | 0.96 | >20 |
| 1427 | H | 3'-Me | 2-NHSO ₂ CH ₃ | + | n.d. | 14 |
| 1430 | H | 3'-Me | 2-NHSO ₂ (4-tBu)Ph | + | 4.8 | 0.9 |
| 1431 | 7-CO ₂ H | 3'-Me | 2-NHSO ₂ (4-tBu)Ph | - | n.d. | >20 |
| 1493 | H | 3'-Me | 2-NHCO(4-tBu)Ph | - | 2.06 | 3 |
| 1512 | H | 3'-Me | 2-NHSO ₂ (4-NHAc)Ph | - | 1.01 | 4 |
| 1514 | H | 3'-Me | 2-NHSO ₂ (3-CF ₃)Ph | + | 1.65 | 3 |
| 1589 | H | 3'-Me | 2-NHSO ₂ (4-NO ₂)Ph | + | 1 | 5 |
| 1590 | H | 3'-Me | 2-NHSO ₂ (4-OMe)Ph | + | 1.12 | 5 |
| 1591 | H | 3'-Me | 2-NHSO ₂ (4-Br)Ph | + | 3.30 | 3 |
| 1592 | H | 3'-Me | 2-NHSO ₂ (4-I)Ph | + | 5.19 | 3 |
| 1593 | H | 3'-Me | 2-NHSO ₂ (4-Ph)Ph | - | 2.22 | 4 |
| 1594 | H | 3'-Me | 2-NHSO ₂ (4-OPh)Ph | - | 3.73 | 5 |
| 1623 | H | H | 2-NHSO ₂ (4-tBu)Ph | + | n.d. | <1 |
| 1639 | H | 3'-Me | 2-NHAc | n.d. | n.d. | >20 |
| 1648 | H | 2-Me | 3'-NHSO ₂ (4-tBu)Ph | + | n.d. | n.d. |

Table 7

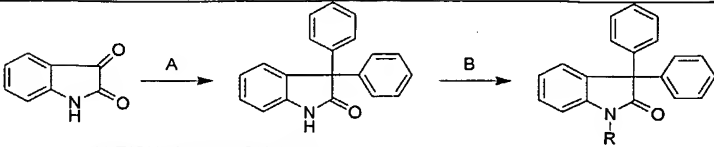
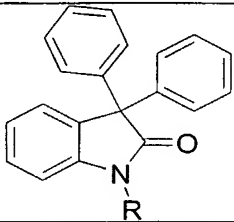
|  <p>A) TfOH, C₆H₆ B) RX, base</p> | | | | |
|---|---|------------------|---------|-----|
|  | | | | |
| Compound | R | Ca ²⁺ | eIF2α-P | SRB |
| 1300 | Ph | - | n.d. | 8 |
| 1301 | Me | + | n.d. | 20 |
| 1302 | -CH ₂ -(4-Cl)Ph | - | n.d. | 14 |
| 1303 | -CH ₂ CHCH ₂ | +/- | n.d. | 15 |
| 1304 | -CH ₂ OH | - | n.d. | 10 |
| 1306 | -SO ₂ (4-O-n-Bu)Ph | - | n.d. | >20 |
| 1307 | -SO ₂ (4-O-Ph)Ph | - | n.d. | >20 |
| 1308 | -SO ₂ (4-NHAc)Ph | - | n.d. | 11 |
| 1309 | -SO ₂ (4-CH ₂ CH ₂ CO ₂ Me)Ph | - | n.d. | 20 |
| 1310 | -SO ₂ (4-OMe)Ph | - | n.d. | 20 |
| 1311 | -SO ₂ (4- <i>t</i> -Bu)Ph | - | n.d. | 11 |

Table 8

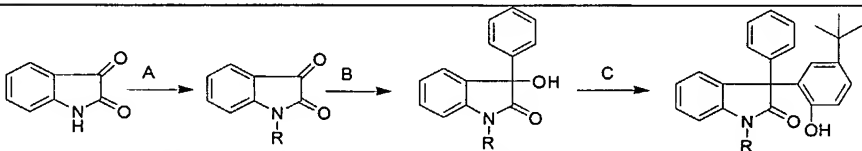
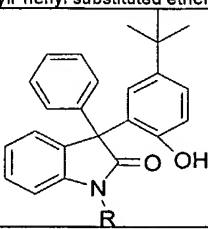
|  <p>A) RX, base B) PhMgBr C) H⁺; 4-<i>t</i>-ButylPhenyl substituted ether</p> | | | | |
|--|---|------------------|---------|-----|
|  | | | | |
| Compound | R | Ca ²⁺ | eIF2α-P | SRB |
| 1227 | -CH ₂ OCH ₂ CHCH ₂ | + | n.d. | 3 |
| 1236 | -CH ₂ CHCH ₂ | +/- | 2.23 | 3 |
| 1255 | -Ph | - | n.d. | 4 |
| 1339 | -CH ₂ COOH | - | n.d. | >20 |

Table 9

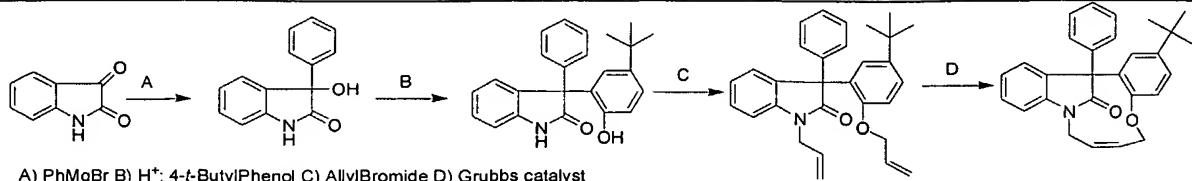
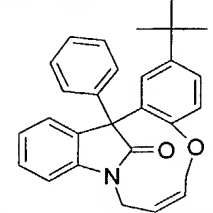
| | | | |
|---|------------------|------------------|-----|
|  <p>A) PhMgBr B) H⁺; 4-<i>t</i>-ButylPhenol C) AllylBromide D) Grubbs catalyst</p> | | | |
|  | | | |
| Compound | Ca ²⁺ | eIF2 α -P | SRB |
| 1291 | - | n.d. | >20 |

Table 10

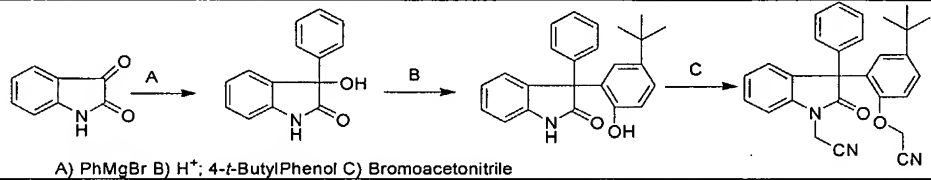
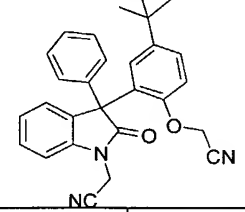
| | | | |
|---|------------------|------------------|-----|
|  <p>A) PhMgBr B) H⁺; 4-<i>t</i>-ButylPhenol C) Bromoacetonitrile</p> | | | |
|  | | | |
| Compound | Ca ²⁺ | eIF2 α -P | SRB |
| 1320 | - | n.d. | 4 |

Table 11

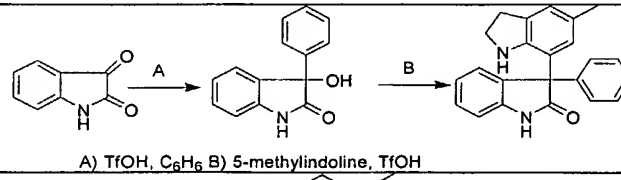
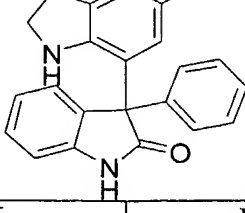
| | | | |
|---|------------------|------------------|-----|
|  <p>A) TfOH, C₆H₆ B) 5-methylindoline, TfOH</p> | | | |
|  | | | |
| Compound | Ca ²⁺ | eIF2 α -P | SRB |
| 1313 | + | n.d. | >20 |

Table 12

34

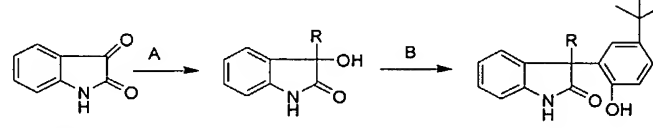
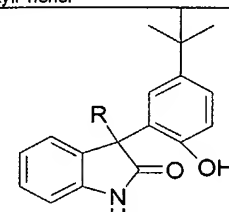
|  <p>A) RMgBr B) H⁺; 4-<i>t</i>-ButylPhenol</p>  | | | | |
|---|---|------------------|---------|-----|
| Compound | R | Ca ²⁺ | eIF2α-P | SRB |
| 1222 | 2-Thiophene | + | n.d. | 9 |
| 1274 | -(CH ₂) ₁₁ CH ₃ | - | 0.91 | 3 |
| 1275 | -CH ₂ Ph | +/- | 1.01 | 13 |
| 1276 | -CCH | + | 0.75 | 13 |
| 1277 | -cyclohexyl | - | 1.08 | 10 |
| 1328 | -C ₆ F ₅ | + | n.d. | 3 |

Table 13

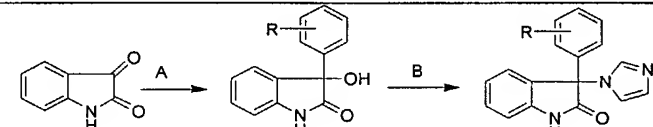
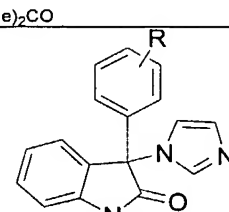
|  <p>A) ArMgBr B) (Imidazole)₂CO</p>  | | | | |
|---|-----------------|------------------|---------|-----|
| Compound | R | Ca ²⁺ | eIF2α-P | SRB |
| 1314 | 3-Cl | + | n.d. | >20 |
| 1315 | H | - | n.d. | >20 |
| 1316 | 3-F | - | n.d. | >20 |
| 1317 | 3-Me | - | n.d. | >20 |
| 1318 | 3- <i>t</i> -Bu | + | n.d. | 2 |

Table 14

EXAMPLE II

Methods of Synthesizing Intermediate and Final Diaryloxindole Compounds

- [71] Compounds described herein were purified either by re-crystallization or by column chromatography, and were characterized by ^1H nuclear magnetic resonance (NMR) and liquid-chromatography-atmospheric pressure chemical ionization-mass spectrometry (LC-APCI-MS).
- [72] As a non-limiting example, isatins and substituted isatins (intermediates set forth in Tables 1, 3, 5 and 7) were synthesized by heating a solution of appropriately protected aniline (0.1 moles), chloral hydrate (0.11 moles), hydroxylamine hydrochloride (0.2 moles) in concentrated H_2SO_4 (12.5 g) and water (700 mL) to 95°C for ten minutes. The solution was then kept at 4°C overnight. The cream colored isonitroso intermediate was filtered off, washed with water and dried. This compound was ground to a fine powder in a mortar and pestle, and added, with stirring, in portions over 30 minutes to concentrated H_2SO_4 (40 g) maintained at $60\text{--}65^\circ\text{C}$. The mixture was then heated at 95°C for one hour and poured onto ice (300g). The resulting solid was filtered to give the appropriate substituted isatin.
- [73] As another non-limiting example, 3-Aryl-3-hydroxy-substituted-oxindoles (intermediates set forth in tables 2-7 and 9-14) were synthesized by adding dropwise a 1M solution of alkyl or aryl magnesium halide (0.33 mole) to an appropriately substituted isatin (0.1 mole) in 60 mL THF at 0°C . The resulting mixture was allowed to warm to room temperature and let spin at room temperature for twelve hours. The reaction mixture was quenched with a saturated solution of NH_4Cl (100 mL) and diluted with 100 mL of dichloromethane. The layers were separated, the organic layer was washed with water followed by brine, dried over Na_2SO_4 and filtered. The filtrate was concentrated *in vacuo* to yield the product.
- [74] As another non-limiting example, symmetric substituted di-aryloxindoles (final compounds set forth in Tables 1 and 8) were synthesized by adding two mL of substituted benzene to a mixture of appropriately substituted isatins (1 mmol) combined with three mL of freshly distilled triflic acid. The resulting mixture was

stirred at room temperature for eight hours. The product mixture was poured over 25 g of ice and extracted into either chloroform or toluene. The organic solution was washed with water and then brine and dried over Na_2SO_4 . Concentration *in vacuo* yielded the 3,3-diphenyl-substituted oxindoles.

- [75] As another non-limiting example, unsymmetrically substituted di-aryloxindoles (final compounds set forth in Tables 2-7 and 9-13) were synthesized by adding freshly distilled triflic acid (1 mmol) in 1 mL dichloromethane to a mixture of appropriately substituted 3-aryl-3-hydroxy-oxindole (0.1 mmol) and appropriately substituted benzene dissolved in 1 mL dichloromethane. The reaction was maintained at room temperature and monitored by thin-layer chromatography (TLC) and liquid chromatography-mass spectrometry (LCMS). Upon completion, the mixture was poured over ice (25 g) and extracted with dichloromethane. The organic layer was dried and concentrated *in vacuo* to yield the desired product.
- [76] As another non-limiting example, unsymmetrically substituted di-aryloxindoles (final compounds set forth in Tables 2-7 and 9-13) were also synthesized by adding p-toluenesulfonic acid (0.3 mmol) in 5 mL dichloromethane to a mixture of appropriately substituted 3-Aryl-3-hydroxy-oxindole (0.1 mmol) and appropriately substituted benzene dissolved in 10 mL dichloroethane. The reaction was heated to 95°C and monitored by TLC and LCMS, upon completion the reaction mixture was cooled and filtered to remove the p-toluenesulfonic acid. The filtrate was concentrated *in vacuo* and purified to yield the desired product.
- [77] As another non-limiting example, 3-(5-tert-butyl-2-hydroxy-phenyl)-3-phenyl-1,3-dihydro-indol-2-one (compound 1181) was synthesized by adding dropwise a 1M solution of phenylmagnesiumbromide (0.33 mole) to isatin (15 g, 0.1 mole) in 60 mL THF at 0°C. The resulting mixture was allowed to warm to room temperature and let stir at room temperature for 12 hours. The reaction mixture was quenched with a saturated solution of NH_4Cl (100 mL) and diluted with 100 mL of dichloromethane. The layers were separated, the organic layer was washed with water followed by brine, dried over Na_2SO_4 , and filtered. The filtrate was concentrated *in vacuo* to yield 20.1 g (90 %) of 3-hydroxy-3-phenyl-1,3-dihydro-indol-2-one. A mixture of the

above solid (2.5 g, 10 mmole), p-*t*-Bu-phenol (1.5 g, 10 mmol), p-toluenesulfonic acid (3 g) in 40 mL dichloroethane, was heated to 95°C for six hours. The mixture was cooled and filtered. The filtrate was concentrated *in vacuo* to yield 2.4 g (66 %) of the desired product (compound 1181).

- [78] As another non-limiting example, 4-*tert*-butyl-N-[5-hydroxy-4-methyl-2-(2-oxo-3-phenyl-2,3-dihydro-1H-indol-3-yl)-phenyl]-benzenesulfonamide (compound 1430) was synthesized by adding dropwise 4-*tert*-butyl-benzenesulfonyl chloride (8g, 34 mmol) in 5 mL dichloromethane to a stirring solution of 5-Amino-2-methyl-phenol (4g, 32 mmol) in 20 mL pyridine and letting the mixture spin overnight at room temperature. The resulting mixture was concentrated *in vacuo* and the product was purified by column chromatography to yield 8g (78 %) of 4-*tert*-butyl-N-(3-hydroxy-4-methyl-phenyl)-benzenesulfonamide. A mixture of 3-hydroxy-3-phenyl-1,3-dihydro-indol-2-one (3.9g, 17 mmol), 4-*tert*-butyl-N-(3-hydroxy-4-methyl-phenyl)-benzenesulfonamide (7g, 22 mmol) and p-toluenesulfonic acid (6.5g, 32 mmol) in dichloroethane was refluxed for 12 hours. The resulting mixture was cooled to room temperature to yield a colorless solid. The solid was filtered and purified using column chromatography to yield 8g (88%) of the desired product (compound 1430).

EXAMPLE III

Analysis of Diaryloxindole Compounds

- [79] Without intending to be bound by theory, the mechanism of action of translation initiation inhibitors is set forth in Figure 1, and includes the depletion (complete or partial depletion) of intracellular calcium (Ca^{2+}) stores and phosphorylation of eIF2 α . Compounds synthesized using the approaches described herein were screened for their ability to partially deplete intracellular Ca^{2+} stores using FURA-2AM loaded cells (Benzaquen et al. (1995) *Nature Medicine*, 1:534, incorporated herein by reference in its entirety for all purposes). A limited subset of compounds were further screened for their ability to deplete endoplasmic reticulum (ER) Ca^{2+} . The Ca^{2+} content of the ER was monitored using ER-targeted, Ca^{2+} sensitive, recombinant proteins. These recombinant proteins emitted light by fluorescent resonance energy transfer (FRET) as a function of the Ca^{2+} content of the medium. Such assays are previously described (Miyawaki, A.; Mizuno, H.; Llopis, J.; Tsien, R. Y.; Jalink, K.

Cameleons as cytosolic and intra-organellar calcium probes, Oxford University Press: Oxford, London, 2001; pp 3-16, incorporated herein by reference in its entirety for all purposes). Compounds that depleted Ca^{2+} were further evaluated for their ability to phosphorylate eIF2 α . eIF2 α phosphorylation was measured by Western blot analysis using the phospho-specific anti-eIF2 α antibody, as previously described (Aktas et al. (1998) *Proc. Natl. Acad. Sci. USA*, 95:8280, incorporated herein by reference in its entirety for all purposes). Compounds that both depleted ER Ca^{2+} and phosphorylated eIF2 α were tested in a lung cancer cell line (A549) for cell growth inhibition as previously described (Palakurthi et al. (2000) *Cancer Research*, 60:2919, incorporated herein by reference in its entirety for all purposes).

- [80] Compound 1181 (set forth in Table 2) was determined to be a Ca^{2+} depleting translation initiation inhibitor, as it depleted ER- Ca^{2+} , phosphorylated eIF2 α , inhibited growth of a cancer cell line (A549), and decreased squamous cell carcinoma tumor mass in mice (Figures 2A-2B, 3A-3C and 5). Using compound 1181 for comparison, additional compounds were screened for their ability to inhibit translation initiation in a Ca^{2+} depletion-dependent manner (Tables 1 to 14).
- [81] One set of compounds (Table 1) had a variation of the functional groups at the positions R_1 and R_2 on the oxindole phenyl ring. Substitutions including, but not limited to, 5-Br, 4-Cl, 5-OCF₃ and 6-Et groups, resulted in compounds that depleted intracellular Ca^{2+} . Compound 1392, which has 4-Cl and 7-CO₂H substitutions, showed improved eIF2 α phosphorylation, which correlated with improved growth inhibition of cancer cells. Compound 1398 (a negative control) exhibited reduced eIF2 α phosphorylation relative to compound 1392, with a concomitant reduced potency of tumor cell growth inhibition.
- [82] The positional effect of a bromo group was next investigated by placing a bromo group at 4, 5, 6 and 7 positions on the phenyl ring of the oxindole to generate compounds 1272, 1205, 1273 and 1207, respectively. The 7-substitution abrogated Ca^{2+} depletion activity, and none of the compounds exhibited an increase in eIF2 α phosphorylation relative to compound 1392.

- [83] Compound 1430 (Table 7) released calcium and showed a 5-fold increase in eIF2 α phosphorylation over DMSO at 5 μ M. Ternary complex assay was 8-fold over DMSO at 20 μ M, and cell growth was inhibited at < 1 μ M. The plasma levels for this in mice were estimated using liquid chromatography and mass spectrometry (LC-MS). Compound 1430 was orally administered at 160 mg/kg, 240 mg/kg, and 320 mg/kg to DBA/2J mice and the plasma concentration was measured at three time points, one hour, three hours, and six hours, and is set forth in Table 15. The plasma was isolated from the mice by heart-lung puncture and the samples were processed and analyzed by LC-MS. The concentrations at each time and dose are in nmoles/mL of plasma (n.d. = not detected; X = not determined).

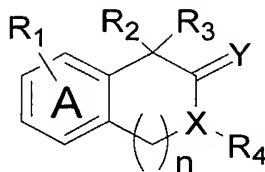
| <u>Time / Dose</u> | <u>320 mg/kg</u> | <u>240 mg/kg</u> | <u>160 mg/kg</u> |
|--------------------|------------------|------------------|------------------|
| 1 hour | 14.0 | 6.8 | 5.7 |
| 3 hours | 3.8 | 4.0 | 3.8 |
| 6 hours | 2.8 | n.d. | X |

Table 15

- [84] Other embodiments will be evident to those of skill in the art. It should be understood that the foregoing description is provided for clarity only and is merely exemplary. The spirit and scope of the present invention are not limited to the above examples, but are encompassed by the following claims. All publications and patent applications cited above are incorporated by reference herein in their entirety for all purposes to the same extent as if each individual publication or patent application were specifically indicated to be so incorporated by reference.

What is claimed is:

1. A compound of formula I:



Formula I

wherein A is selected from the group consisting of carbocyclic aromatic ring, heterocyclic ring and heteroaromatic ring;

R₁ is selected from the group consisting of (halo)alkyl, (un)substituted (alkyl)aryl, halogen, CN, COOH, alkenyl, alkynyl, alkoxy and cycloalkoxy;

R₂ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr;

R₃ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr;

R₄ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr;

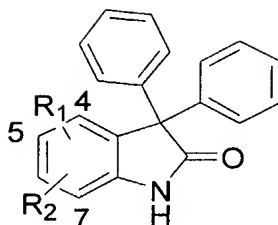
X is selected from the group consisting of unsubstituted or substituted nitrogen, oxygen, sulfur and carbon;

Y is selected from the group consisting of unsubstituted or substituted nitrogen, oxygen and sulfur and carbon; and

n = 0-4.

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2. A compound of formula II:

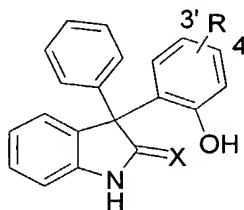


Formula II

wherein R_1 is selected from the group consisting of H, 5-bromo, 5-chloro, 7-bromo, 5-iodo, 5-OCF₃, 5-sulfonic acid, 5-nitro, 4-bromo, 6-bromo, 5-ethyl, 7-ethyl, 4-ethyl, 6-ethyl, 7-iodo, 5-fluoro, 7-COOH, 7-COOMe and 4-Cl; and

R_2 is selected from the group consisting of 7- formamide-N-[2-(4-amino-phenyl)-ethyl], 7-CO₂H, 7-CH₂OH, 7-CH₂-N-imidazole and H.

3. A compound of formula III:



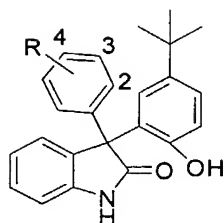
Formula III

wherein X is selected from the group consisting of oxygen, NH and CH₂; and

R is selected from the group consisting of 3'-CH₂CH(CO₂Me)NH₂, 3'-CH₂CH(CO₂Me)NHFmoc, 3'-t-Bu, 3'-OH, 3'-O(CH₂)₃CHCH₂, 3'-O(CH₂)₄Br, 3'-O(CH₂)₄NMe₂, 3'-O(CH₂)₄N₃, 3'- , 3'-O(CH₂)₄NH₂, 3'-CF₃, 3'-CH₃, 3'-n-heptyl, 3'-n-nonyl, 3'-i-Bu, 3'-i-propyl, 3'-n-propyl, 3'-n-octyl, 3'-Et, 3'-n-pentyl, 3'-n-Bu, 3'-n-hexyl, 3'-n-cyclopentyl, 3'-n-cyclohexyl, 4-NHSO₂(4-tBu)Ph and 3'-NHSO₂(4-tBu)Ph.

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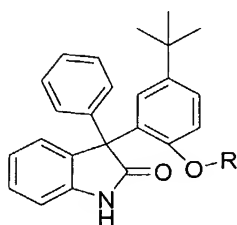
4. A compound of formula IV:



Formula IV

wherein R is selected from the group consisting of 4-F, 4-O(CH₂)₃CHCH₂, 3-Cl, 3-F, 3-Me, 2-Me and 2-OMe.

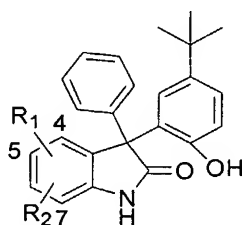
5. A compound of formula V:



Formula V

wherein R is selected from the group consisting of -SO₂-Camphor, -CO(CH₂)₆CO₂H, -CO(CH₂)₃CONHOH, -CH₂CH₂NHBoc, -CO(CH₂)₃CO₂H, -CH₂CO₂H, -CH₂CO-Leu-Phe-CH₂OH and -CH₂CO₂Me.

6. A compound of formula VI:



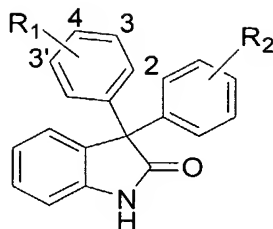
Formula VI

wherein R₁ is selected from the group consisting of 7-Br, 4-Cl, 5-Br, 5-NO₂, 5-I, 5-OMe, 5-Cl, 7-CF₃, 5-NH₂, 4-Br, 6-Br, H, 7-OMe, 7-I, 5-Et, 7-Et, 4-Et, 6-Et, 5-F, 5-N₃, 7-COOH, 7-CO₂H, 4-Cl, 6-Cl and 5-NHSO₂-1-naphthyl; and

R₂ is H or 7-CO₂H.

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7. A compound of formula VII:

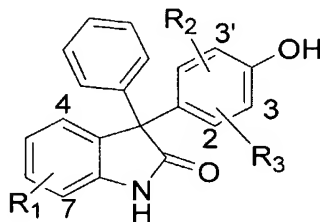


Formula VII

wherein R_1 is selected from the group consisting of H, 2-OH, 3-O(CH₂)₄NMe₂, 3-O(CH₂)₄N₃, 3-*t*-Bu, 2-OMe, 3-OMe, 4-OH, 4-OPh, 4-Ph, 4-NMe₂, 4-*n*-propyl, 4-*i*-Bu, 4-*n*-Bu, 4-O(CH₂)₂OH, 4-OMe, 2-CH₂CO₂H and 4-*t*-Bu; and

R_2 is selected from the group consisting of 2-OH, 4-OH, 4-*t*-Bu and H.

8. A compound of formula VIII:



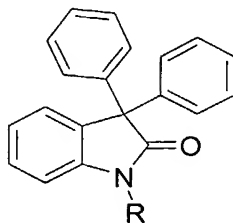
Formula VIII

wherein R_1 is selected from the group consisting of H and 7-CO₂H;

R_2 is selected from the group consisting of H, 2-Me, 3'-Me, 3-F and 3-CF₃; and

R_3 is selected from the group consisting of H, 2-NHFmoc, 2-NHSO₂CH₂Ph, 2-NHSO₂CH₃, 2-NHSO₂(4-*t*Bu)Ph, 2-NHSO₂(4-NHAc)Ph, 2-NHSO₂(3-CF₃)Ph, 2-NHSO₂(4-NO₂)Ph, 2-NHSO₂(4-OMe)Ph, 2-NHSO₂(4-Br)Ph, 2-NHSO₂(4-I)Ph, 2-NHSO₂(4-Ph)Ph, 2-NHSO₂(4-OPh)Ph, 2-NHAc, 2-NHCO(4-*t*Bu)Ph and 3'-NHSO₂(4-*t*Bu)Ph.

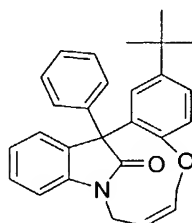
9. A compound of formula IX:



Formula IX

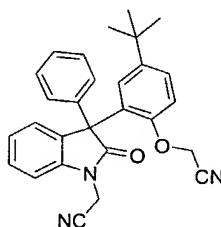
wherein R is selected from the group consisting of Ph, Me, $-\text{CH}_2-(4\text{-Cl})\text{Ph}$, $-\text{CH}_2\text{CHCH}_2$, $-\text{CH}_2\text{OH}$, $-\text{CH}_2\text{CO}_2\text{H}$, $-\text{CH}_2\text{OCH}_2\text{CHCH}_2$, $-\text{SO}_2(4\text{-O-n-Bu})\text{Ph}$, $-\text{SO}_2(4\text{-O-Ph})\text{Ph}$, $-\text{SO}_2(4\text{-NHAc})\text{Ph}$, $-\text{SO}_2(4\text{-CH}_2\text{CH}_2\text{CO}_2\text{Me})\text{Ph}$, $-\text{SO}_2(4\text{-OMe})\text{Ph}$ and $-\text{SO}_2(4\text{-t-Bu})\text{Ph}$.

10. A compound of formula X:



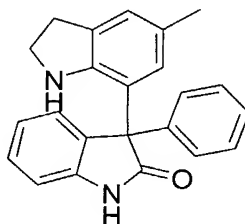
Formula X.

11. A compound of formula XI:



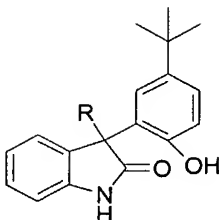
Formula XI.

12. A compound of formula XII:



Formula XII.

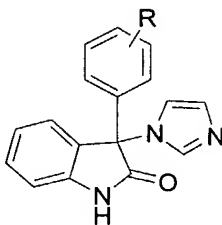
13. A compound of formula XIII:



Formula XIII

wherein R is selected from the group consisting of 2-Thiophene, $-(CH_2)_{11}CH_3$, $-CH_2Ph$, $-CCH_3$, -cyclohexyl and $-C_6F_5$.

14. A compound of formula XIV:



Formula XIV

wherein R is selected from the group consisting of H, 3-Cl, 3-F, 3-Me and 3-t-Bu.

15. A compound for inhibiting translation, wherein said compound is selected from formulae I-XIV above.

16. A method of treating a cellular proliferative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal the compound of claim 15.

17. The method of claim 16, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

18. A method of treating a cellular proliferative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human

mammal a compound selected from formulae I-XIV above in an amount effective to deplete intracellular calcium stores of an aberrantly proliferating cell.

19. The method of claim 18, wherein said cellular proliferative disorder is cancer.

20. A method of treating a viral infection in a human or non-human mammal in need thereof, the method comprising administering to a human or non-human mammal a compound selected from formulae I-XIV above.

21. The method of claim 20, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

22. A method of treating a viral infection in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal a compound selected from formulae I-XIV above in an amount effective to deplete intracellular calcium stores of an infected cell.

23. The method of claim 22, wherein viral translation is inhibited.

24. A method of treating a non-proliferative, degenerative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal the compound of claim 15.

25. The method of claim 24, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

26. A method of treating a non-proliferative, degenerative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal a compound selected from formulae I-XIV above in an amount effective to

deplete intracellular calcium stores of a cell associated with a non-proliferative, degenerative disorder.

27. The method of claim 26, wherein said non-proliferative, degenerative disorder is Alzheimer's disease or insulin resistance.

28. A method of treating a disorder associated with a viral infection in a human or non-human mammal in need thereof, the method comprising administering to a human or non-human mammal a compound selected from formulae I-XIV above.

29. The method of claim 28, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

30. A method of treating a disorder associated with a viral infection in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal a compound selected from formulae I-XIV above in an amount effective to deplete intracellular calcium stores of an infected cell.

31. The method of claim 30, wherein viral translation is inhibited.

32. A kit containing a pharmaceutical composition comprising:
a compound selected from formulae I-XIV above and a pharmaceutically acceptable carrier for treatment of one or more of a cellular proliferative disorder or a viral infection.

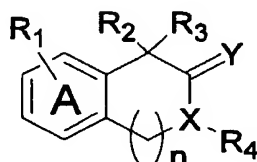
33. The kit of claim 32, further comprising instructions for use.

34. The kit of claim 32, wherein said pharmaceutical composition is administered to a human subject.

AMENDED CLAIMS

[received by the International Bureau on 18 July 2005 (18.07.2005);
original claims 2, 7, 9 amended]

1. A compound of formula I:



Formula I

wherein A is selected from the group consisting of carbocyclic aromatic ring, heterocyclic ring and heteroaromatic ring;

R₁ is selected from the group consisting of (halo)alkyl, (un)substituted (alkyl)aryl, halogen, CN, COOH, alkenyl, alkynyl, alkoxy and cycloalkoxy;

R₂ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr;

R₃ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr;

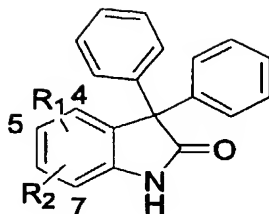
R₄ is selected from the group consisting of (un)substituted aryl, (un)substituted heterocyclic, (un)substituted heteroaromatic, Ar-NHSO₂Ar and Ar-NHCOAr;

X is selected from the group consisting of unsubstituted or substituted nitrogen, oxygen, sulfur and carbon;

Y is selected from the group consisting of unsubstituted or substituted nitrogen, oxygen and sulfur and carbon; and

n = 0-4.

2. A compound of formula II:

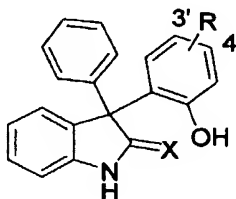


Formula II

wherein R_1 is selected from the group consisting of H, 5-bromo, 5-chloro, 7-bromo, 5-iodo, 5-OCF₃, 5-sulfonic acid, 5-nitro, 4-bromo, 6-bromo, 5-ethyl, 7-ethyl, 4-ethyl, 6-ethyl, 7-iodo, 5-fluoro, 7-COOH, 7-COOMe and 4-Cl; and

R_2 is selected from the group consisting of 7- formamide-N-[2-(4-amino-phenyl)-ethyl], 7-CO₂H, 7-CH₂OH, 7-CH₂-N-imidazole and H with the proviso that R_1 and R_2 cannot both be H, and with the further proviso that when R_2 is H, R_1 cannot be 5-chloro, 5-nitro or 5-fluoro.

3. A compound of formula III:

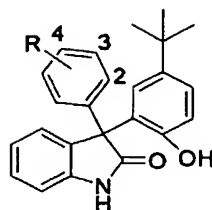


Formula III

wherein X is selected from the group consisting of oxygen, NH and CH₂; and

R is selected from the group consisting of 3'-CH₂CH(CO₂Me)NH₂, 3'-CH₂CH(CO₂Me)NHFmoc, 3'-t-Bu, 3'-OH, 3'-O(CH₂)₃CHCH₂, 3'-O(CH₂)₄Br, 3'-O(CH₂)₄NMe₂, 3'-O(CH₂)₄N₃, 3'-CH₂-C(=O)-NH-C(=O)-S-, 3'-O(CH₂)₄NH₂, 3'-CF₃, 3'-CH₃, 3'-n-heptyl, 3'-n-nonyl, 3'-i-Bu, 3'-i-propyl, 3'-n-propyl, 3'-n-octyl, 3'-Et, 3'-n-pentyl, 3'-n-Bu, 3'-n-hexyl, 3'-n-cyclopentyl, 3'-n-cyclohexyl, 4-NHSO₂(4-tBu)Ph and 3'-NHSO₂(4-tBu)Ph.

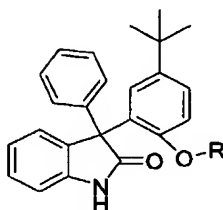
4. A compound of formula IV:



Formula IV

wherein R is selected from the group consisting of 4-F, 4-O(CH₂)₃CHCH₂, 3-Cl, 3-F, 3-Me, 2-Me and 2-OMe.

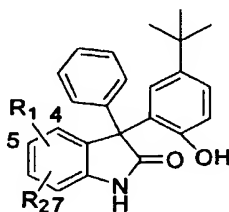
5. A compound of formula V:



Formula V

wherein R is selected from the group consisting of -SO₂-Camphor, -CO(CH₂)₆CO₂H, -CO(CH₂)₃CONHOH, -CH₂CH₂NHBoc, -CO(CH₂)₃CO₂H, -CH₂CO₂H, -CH₂CO-Leu-Phe-CH₂OH and -CH₂CO₂Me.

6. A compound of formula VI:

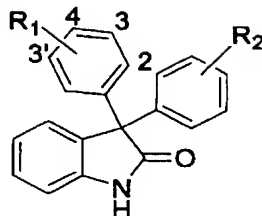


Formula VI

wherein R₁ is selected from the group consisting of 7-Br, 4-Cl, 5-Br, 5-NO₂, 5-I, 5-OMe, 5-Cl, 7-CF₃, 5-NH₂, 4-Br, 6-Br, H, 7-OMe, 7-I, 5-Et, 7-Et, 4-Et, 6-Et, 5-F, 5-N₃, 7-COOH, 7-CO₂H, 4-Cl, 6-Cl and 5-NHSO₂-1-naphthyl; and

R₂ is H or 7-CO₂H.

7. A compound of formula VII:

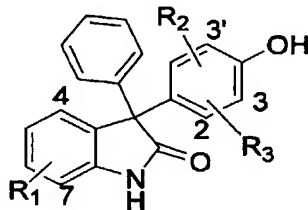


Formula VII

wherein R_1 is selected from the group consisting of H, 2-OH, 3-O(CH₂)₄NMe₂, 3-O(CH₂)₄N₃, 3-t-Bu, 2-OMe, 3-OMe, 4-OH, 4-OPh, 4-Ph, 4-NMe₂, 4-n-propyl, 4-i-Bu, 4-n-Bu, 4-O(CH₂)₂OH, 4-OMe, 2-CH₂CO₂H and 4-t-Bu; and

R_2 is selected from the group consisting of 2-OH, 4-OH, 4-t-Bu and H, with the proviso that R_1 and R_2 cannot both be H.

8. A compound of formula VIII:



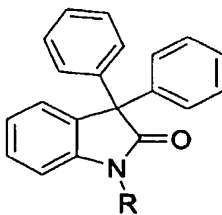
Formula VIII

wherein R_1 is selected from the group consisting of H and 7-CO₂H;

R_2 is selected from the group consisting of H, 2-Me, 3'-Me, 3-F and 3-CF₃; and

R_3 is selected from the group consisting of H, 2-NHFmoc, 2-NHSO₂CH₂Ph, 2-NHSO₂CH₃, 2-NHSO₂(4-tBu)Ph, 2-NHSO₂(4-NHAc)Ph, 2-NHSO₂(3-CF₃)Ph, 2-NHSO₂(4-NO₂)Ph, 2-NHSO₂(4-OMe)Ph, 2-NHSO₂(4-Br)Ph, 2-NHSO₂(4-I)Ph, 2-NHSO₂(4-Ph)Ph, 2-NHSO₂(4-OPh)Ph, 2-NHAc, 2-NHCO(4-tBu)Ph and 3'-NHSO₂(4-tBu)Ph.

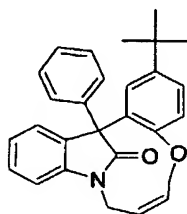
9. A compound of formula IX:



Formula IX

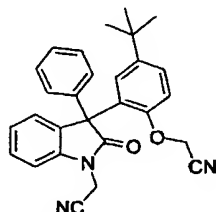
wherein R is selected from the group consisting of ~~Ph~~-Me, -CH₂-(4-Cl)Ph, -CH₂CHCH₂, -CH₂OH, -CH₂CO₂H, -CH₂OCH₂CHCH₂, -SO₂(4-O-n-Bu)Ph, -SO₂(4-O-Fh)Ph, -SO₂(4-NHAc)Ph, -SO₂(4-CH₂CH₂CO₂Me)Ph, -SO₂(4-OMe)Ph and -SO₂(4-t-Bu)Ph.

10. A compound of formula X:



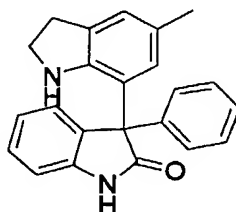
Formula X.

11. A compound of formula XI:



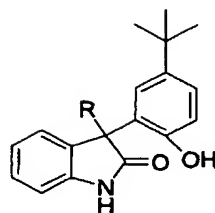
Formula XI.

12. A compound of formula XII:



Formula XII.

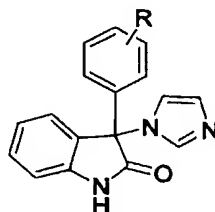
13. A compound of formula XIII:



Formula XIII

wherein R is selected from the group consisting of 2-Thiophene, $-(CH_2)_{11}CH_3$, $-CH_2Ph$, $-CCH_3$, $-cyclohexyl$ and $-C_6F_5$.

14. A compound of formula XIV:



Formula XIV

wherein R is selected from the group consisting of H, 3-Cl, 3-F, 3-Me and 3-t-Bu

15. A compound for inhibiting translation, wherein said compound is selected from formulae I-XIV above.

16. A method of treating a cellular proliferative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal the compound of claim 15.

17. The method of claim 16, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

18. A method of treating a cellular proliferative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human

mammal a compound selected from formulae I-XIV above in an amount effective to deplete intracellular calcium stores of an aberrantly proliferating cell.

19. The method of claim 18, wherein said cellular proliferative disorder is cancer.

20. A method of treating a viral infection in a human or non-human mammal in need thereof, the method comprising administering to a human or non-human mammal a compound selected from formulae I-XIV above.

21. The method of claim 20, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

22. A method of treating a viral infection in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal a compound selected from formulae I-XIV above in an amount effective to deplete intracellular calcium stores of an infected cell.

23. The method of claim 22, wherein viral translation is inhibited.

24. A method of treating a non-proliferative, degenerative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal the compound of claim 15.

25. The method of claim 24, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

26. A method of treating a non-proliferative, degenerative disorder in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal a compound selected from formulae I-XIV above in an amount effective to

deplete intracellular calcium stores of a cell associated with a non-proliferative, degenerative disorder.

27. The method of claim 26, wherein said non-proliferative, degenerative disorder is Alzheimer's disease or insulin resistance.

28. A method of treating a disorder associated with a viral infection in a human or non-human mammal in need thereof, the method comprising administering to a human or non-human mammal a compound selected from formulae I-XIV above.

29. The method of claim 28, wherein the compound is administered by inhalation, transdermally, orally, rectally, transmucosally, intestinally, parenterally, intramuscularly, subcutaneously or intravenously.

30. A method of treating a disorder associated with a viral infection in a human or non-human mammal in need thereof, the method comprising administering to the human or non-human mammal a compound selected from formulae I-XIV above in an amount effective to deplete intracellular calcium stores of an infected cell.

31. The method of claim 30, wherein viral translation is inhibited.

32. A kit containing a pharmaceutical composition comprising:
a compound selected from formulae I-XIV above and a pharmaceutically acceptable carrier for treatment of one or more of a cellular proliferative disorder or a viral infection.

33. The kit of claim 32, further comprising instructions for use.

34. The kit of claim 32, wherein said pharmaceutical composition is administered to a human subject.

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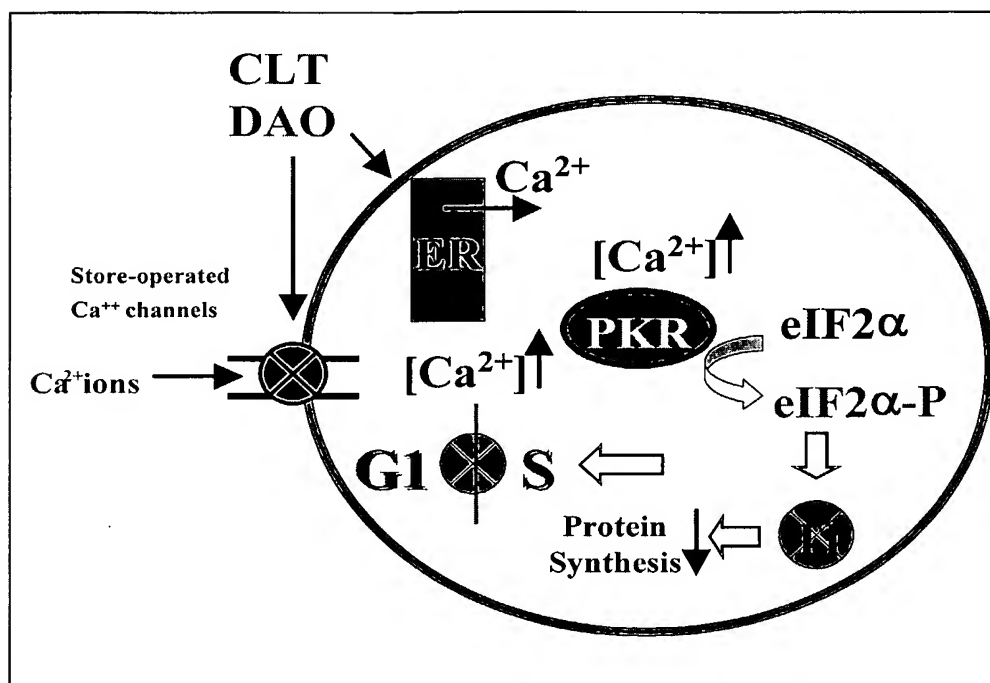


Figure 1

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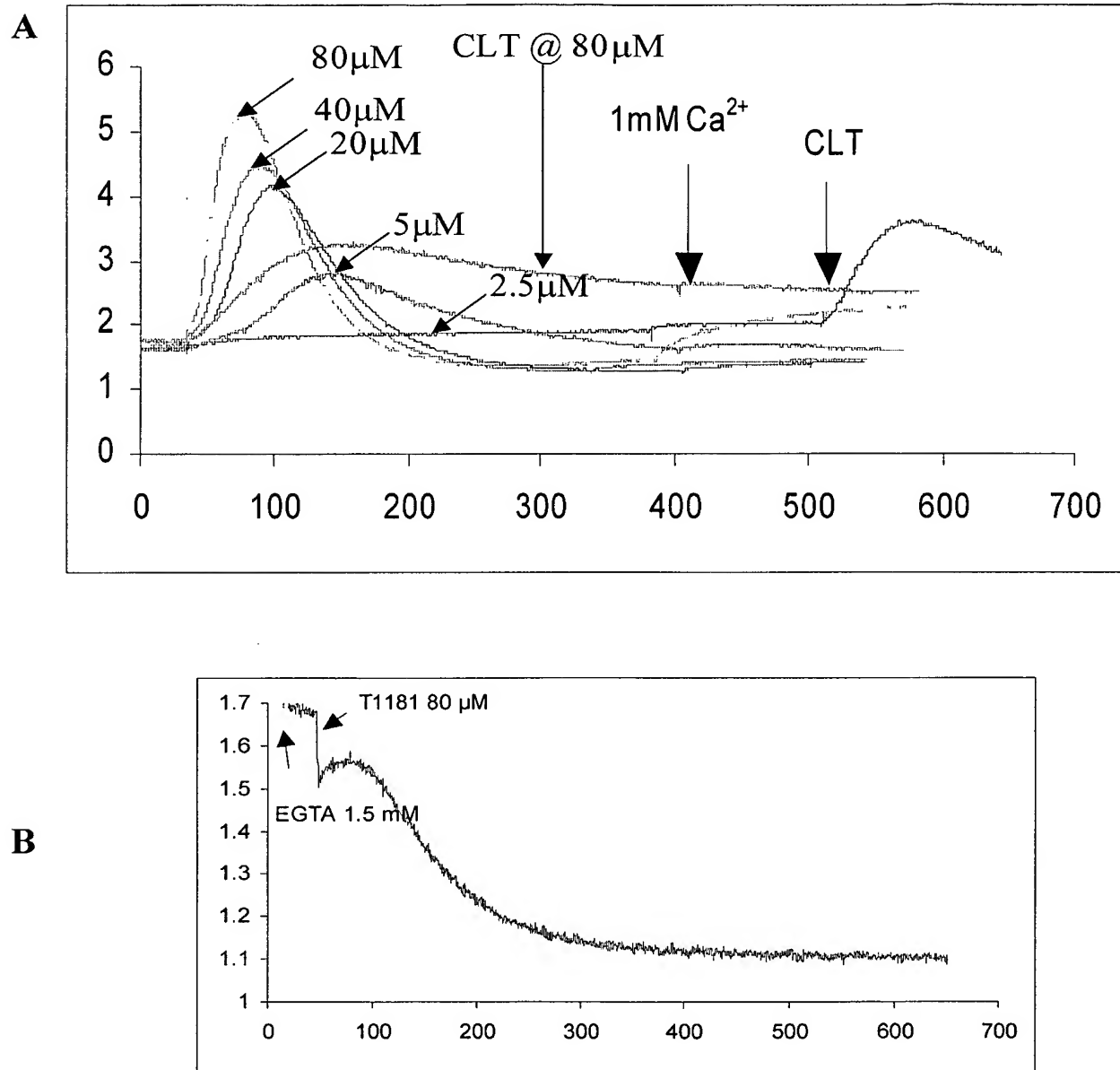
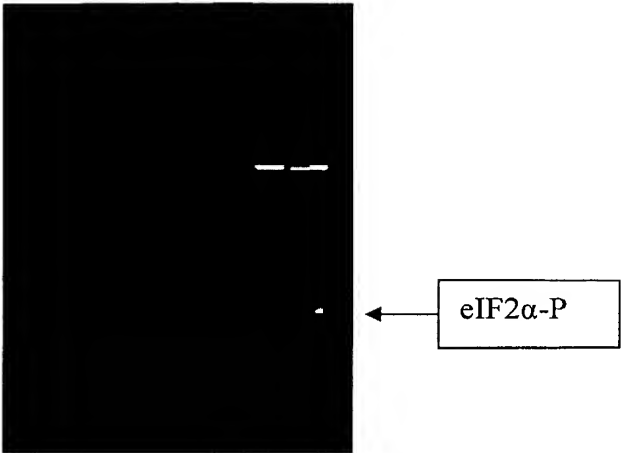


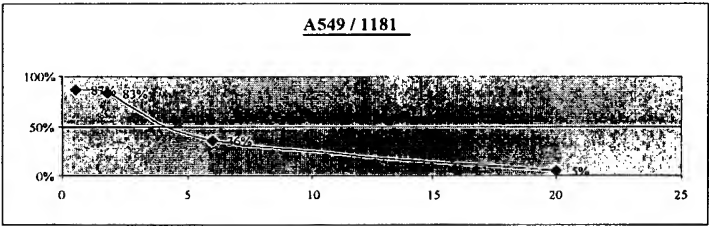
Figure 2

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A



B



C

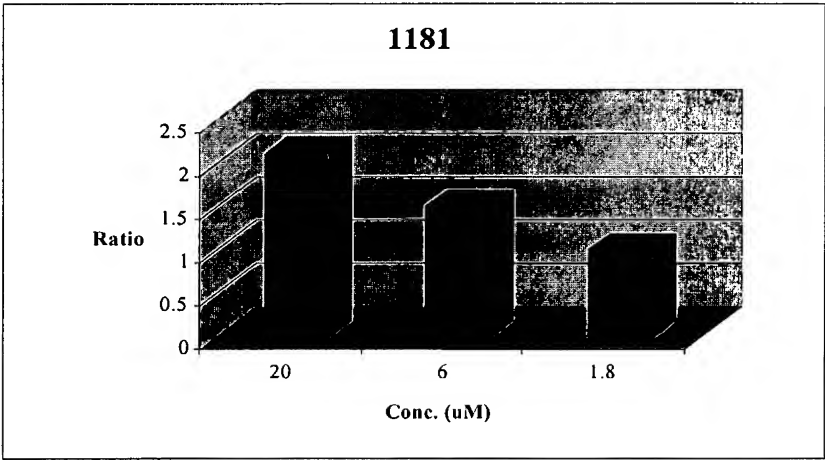
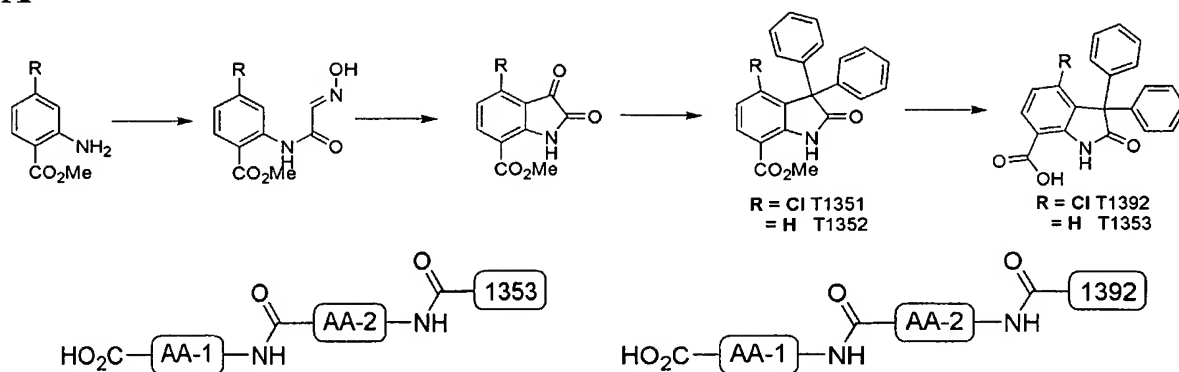


Figure 3

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A**B**

| AA1 → | Met | Pro | Asn | Ala | Asp |
|----------|-----|-----|-----|-----|-----|
| Leu | ✓ | ✓ | ✓ | ✓ | ✓ |
| Phe | ✓ | ✓ | × | ✓ | ✓ |

| AA1 → | Met | Pro | Asn | Ala | Asp |
|----------|-----|-----|-----|------|-----|
| Leu | ✓ | ✓ | ✓ | n.d. | ✓ |
| Phe | ✓ | ✓ | × | ✓ | × |

| AA1 → | Phe | Thr |
|----------|-----|-----|
| Ala | ✓ | ✓ |
| Gln | ✓ | ✓ |
| Leu | ✓ | ✓ |
| Phe | ✓ | ✓ |
| Trp | ✓ | ✓ |

| AA1 → | Phe | Thr |
|----------|-----|-----|
| Ala | ✓ | ✓ |
| Gln | ✓ | ✓ |
| Leu | ✓ | ✓ |
| Phe | ✓ | ✓ |
| Trp | ✓ | ✓ |

Figure 4

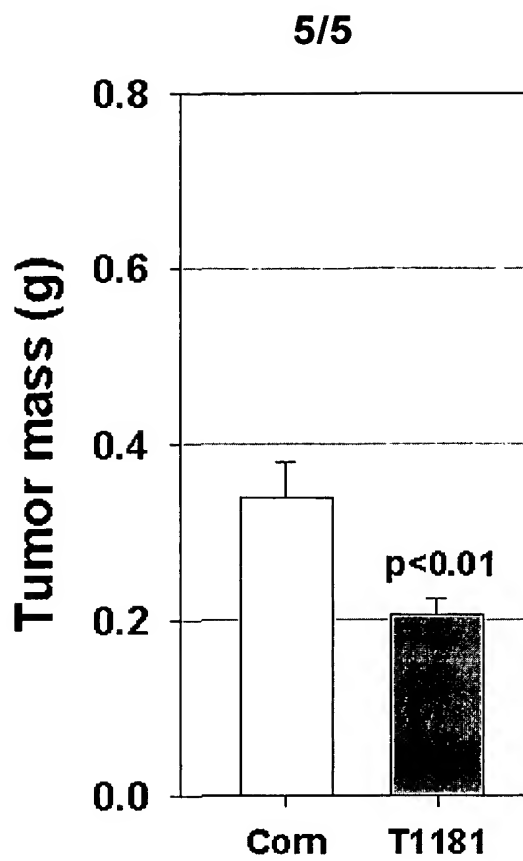
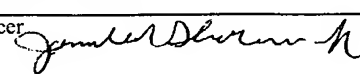


Figure 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/04373

| A. CLASSIFICATION OF SUBJECT MATTER IPC(7) : C07D 209/34 US CL : 548/487 According to International Patent Classification (IPC) or to both national classification and IPC | | |
|--|--|---|
| B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 548/487; 548/486 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| X | Klumpp, D.A. Preparation of 3,3-Diaryloxindoles by Superacid-Induced Condensations of Isatins and Aromatics with a Combinatorial Approach. March 1998, Vol. 63, pages 4481-4484, especially page 4482. | 2 |
| Y | JP 2003176269A2 (Mitsubishi Welfharma Co.) 24 June 2003 (24.06.03), Claim 1, page 1. | 2 |
| P | Halperin, J.A. Novel Arylsulfoanilide-Oxindole Hybrid as an Anticancer Agent that Inhibits Translation Initiation. October 2004, Vol. 47, No. 21, pages 4979-4982, especially page 4979. | 2 |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex. | | |
| * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family | | |
| Date of the actual completion of the international search 04 May 2005 (04.05.2005) | | Date of mailing of the international search report 19 MAY 2005 |
| Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230 | | Authorized officer  Susannah Lee Telephone No. 571-272-6098 |

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/04373

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 1 and 3-34
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Please See Continuation Sheet
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/04373

Box II Observations where certain claims were found unsearchable 1. because they relate to subject matter not required to be searched by this Authority, namely:

The numerous variables, e.g. carbocyclic aromatic ring, heterocyclic ring and heteroaromatic ring, (un)substituted heterocyclic, (un)substituted heteroaromatic, etc... and their voluminous complex meanings and their virtual incomprehensible permutations and combinations make it impossible to determine the full scope and complete meaning of the claimed subject matter. As presented the claimed subject matter cannot be regarded as being a clear and concise description for which protection is sought and as such the listed claims do not comply with the requirements of PCT Article 6. Thus it is impossible to carry out a meaningful written opinion on same. A written opinion will be carried out on the first discernable invention, which is the compound of claim 2, 3,3-diphenylindolin-2-one.